United States
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Natural
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NATIONAL SOIL SURVEY HANDBOOK

Title 430 NATIONAL SOIL SURVEY HANDBOOK

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NATIONAL SOIL SURVEY HANDBOOK

PREFACE

The National Soil Survey Handbook (NSSH) as a subdivision of the NRCS directives system includes parts 600 through 659, title 430 soil survey. Within the NSSH are parts and handbooks that provide the main operational and procedural guidance for the soil survey program. Several part numbers are intentionally omitted to allow for expansion.

The format is intended to allow flexibility for additions and updates, and provide an overall structure for all soil survey handbooks within the 600 series of the NRCS directives system.

Soil survey staff at the National Soil Survey Center (NSSC) in Lincoln, Nebraska are primary authors to this handbook. Comments or questions on this handbook should be addressed to the National Leader, Soil Survey Standards at the National Soil Survey Center.

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GENERAL

Unlisted parts are reserved.

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Part 600 - INTRODUCTION

600.00 The Mission of the Soil Survey Division, Natural Resources Conservation Service.

Provide leadership and service to produce and deliver scientifically-based soil information to help society to understand, value, and wisely manage global resources.

600.01 Purpose.

The National Soil Survey Handbook and other technical and procedural references provide the standards, guidelines, definitions, policy, responsibilities, and procedures for conducting the National Cooperative Soil Survey in the United States.

600.02 National Cooperative Soil Survey (NCSS) Standards.

NCSS standards are common or shared procedures that enhance technology transfer, data sharing, and communications among soil survey participants.

NCSS standards apply to various soil survey functions. The many references listed in Exhibit 600-1 contain standards.

600.03 Principal References and Their Maintenance.

The three principal publications guiding the NCSS are the *Soil Survey Manual*, *Soil Taxonomy*, and the National Soil Survey Handbook. Exhibit 600-1 is a list of other technical references that are important in gathering and applying soil knowledge. The following paragraphs describe how these publications are revised and how they apply to the NCSS in the United States.

(a) The *Soil Survey Manual*.
The purpose of the Soil Survey Manual is to provide the major principles and concepts for making and using soil surveys and the standards and conventions for describing soils. The manual is intended primarily for use by soil scientists engaged in making and interpreting soil surveys. It is also the basic reference for soil survey users who desire to learn the scientific methods that form the basis for soil surveys. It discusses general procedures to illustrate and explain the principles and concepts, but the National Soil Survey Handbook presents current operational procedures of the NRCS in more detail.

Amendments may be issued to the *Soil Survey Manual* as NRCS directives. Proposals to the manual may originate from any interested individual or group participating in the NCSS or from staffs of foreign soil survey organizations. The originating group or author forwards the proposal to the National Leader for Soil Classification and Standards.

(b) *Soil Taxonomy* and the *Keys to Soil Taxonomy*.
Agricultural Handbook 436, second edition Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys (1999), provides the common base for the organization of knowledge about soils and the standards for their classification. The Keys to Soil Taxonomy, which is periodically revised, provides excerpts of *Soil Taxonomy* that can be readily used in the field and contains all the approved revisions and amendments to *Soil Taxonomy*. Procedures to amend *Soil Taxonomy* are outlined in part 614.

(c) The National Soil Survey Handbook.
The National Soil Survey Handbook provides guidelines, definitions, policy, responsibilities, and procedures for conducting the NRCS part of the NCSS. It contains information relative to planning and managing soil surveys, collecting and maintaining soil survey information, and distributing the information to users. The National Soil Survey Handbook provides specific information about the field activities, correlation, interpretation, publication, and dissemination of soil surveys of the NCSS.

The National Soil Survey Center updates the National Soil Survey Handbook on a periodic basis. Any member of the NCSS may suggest changes or additions to the handbook. The originating author sends the proposed changes or additions, along with an explanation of and support for the need for the change or addition, to the National Soil Survey Center. The Center reviews proposed changes, amendments, and additions at least annually. The Director, Soil Survey Division, issues the changes to holders of the National Soil Survey Handbook.

The National Soil Survey Handbook is not to be amended or supplemented by offices other than the National Soil Survey Center.

(d) User Manuals.
User manuals contain procedures for conducting soil survey activities, such as those related to the electronic storage and display of soil information. Examples are the User Guides for the National Soil Information System.

(e) Guides.
Guides provide special information and criteria for various functions, such as interpreting soils and updating major land resource areas. Regional guides may be developed and used as needed to supplement national guides.

Exhibit 600-1 List of Technical References.

Aerial-Photo Interpretation in Classifying and Mapping Soils, Agricultural Handbook 294, 1973, USDA, SCS.

Agricultural Handbook 18, Soil Survey Manual, 1993, USDA. http://soils.usda.gov/procedures/ssm/main.htm

Agricultural Handbook 210, Land Capability Classification, 1973, USDA, SCS. Exhibit 622-2 NSSH. http://soils.usda.gov/procedures/handbook/content/622-ex2.htm#ex2

Agricultural Handbook 296, Land Resource Regions and Major Land Resource Areas of the United States, 1981, USDA, SCS, 156 pp., illus. http://soils.usda.gov/soil_survey/geography/mlra/ag_handbook.htm

Agricultural Handbook 346, Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, USDA, SCS.

Agricultural Handbook 436, second edition, Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys, Soil Survey Staff, 1999, USDA, NRCS; and all Amendments. http://soils.usda.gov/classification/taxonomy/main.htm

Agricultural Handbook 703, Predicting Soil Erosion By Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), 1997, USDA, ARS.

Agricultural Salinity Assessment and Management, ASCE Manuals and Reports on Engineering Practice, Number 71, 1990, American Society of Civil Engineers.

ASTM, D2487, Standard Test Method for Classification of Soils for Engineering Purposes. (Unified Soil Classification System) http://www.astm.org/cgi-bin/SoftCart.exe/STORE/store.htm?E+mystore

ASTM, D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). http://www.astm.org/cgi-bin/SoftCart.exe/STORE/store.htm?E+mystore

Basic Photo Interpretation: A Comprehensive Approach to Interpretation of Vertical Aerial Photography for Natural Resource Application, USDA, SCS.

Block Diagrams for Soil Survey Interpretation, USDA, SCS.

Cartographic information from the National Cartographic and Geospatial Center. http://www.ftw.nrcs.usda.gov/ncg/ncg.html

Checklist of United States Trees (Native and Naturalized), Little, Elbert L., Jr., Agricultural Handbook 541, 1979, USDA, FS, Washington, D.C., 375 pp.

Code of Federal Regulations, title 7, part 657--Prime and Unique Farmlands http://www.access.gpo.gov/nara/cfr/waisidx_00/7cfr657_00.html

Field Book for Describing and Sampling Soils, (current version) USDA, NRCS http://soils.usda.gov/procedures/field_bk/main.htm

Field Indicators of Hydric Soils of the United States, (current version), USDA, NRCS. http://soils.usda.gov/soil_use/hydric/field_ind.pdf

Forest Cover Types of the United States and Canada, Eyre, F.H., editor, 1980, Society of American Foresters, Washington, D.C., 148 pp., map packet.

General Manual, Title 430, current issue, USDA, NRCS. http://policy.nrcs.usda.gov/scripts/lpsiis.dll/GM/GM_430.htm

Handbook of Soil Survey Investigations Field Procedures, 1971, USDA, SCS.

Hydric Soils of the United States, USDA, NRCS
http://soils.usda.gov/soil_use/hydric/main.htm

Inventorying, Classifying, and Correlating Juniper and Pinyon Communities to Soils in Western United States" Grazing Land Technology Institute, September 1997, USDA, NRCS

Keys to Soil Taxonomy, Soil Survey Staff, (current issue), USDA, NRCS
http://soils.usda.gov/classification/keys/main.htm

National Agronomy Manual, (current issue), USDA, NRCS

National Biology Manual, USDA, NRCS, (current issue).

National Cartographic Technical References, USDA, NRCS.
http://www.ftw.nrcs.usda.gov/ncg/ncg.html

National Engineering Handbook, USDA, NRCS, (current issue).

National Food Security Act Manual, USDA, NRCS, (current issue).

National Forestry Manual, USDA, NRCS, (current issue).

National Range and Pasture Handbook, USDA, NRCS, (current issue).
http://www.ftw.nrcs.usda.gov/pdf/NRPH.PDF

National Soil Characterization Database, USDA, NRCS.
http://soils.usda.gov/soil_survey/nscd/main.htm

National Soil Information System User Documents
http://nasis.nrcs.usda.gov/documents/

Official Series Description File Handbook, (current issue), USDA, NRCS.
http://ortho.ftw.nrcs.usda.gov/osd/osd.html/

Pedon Description Program Users Manual, USDA, SCS, (current issue).

Plants database
http://plants.usda.gov/

Soil Classification File Handbook, (current issue), USDA, NRCS.
http://ortho.ftw.nrcs.usda.gov/osd/sc.html

Soil Survey Investigation Reports, National Soil Survey Laboratory, USDA, SCS, (issued for various states).

Soil Survey Investigations Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, July 1984, USDA, SCS.

Soil Survey Investigations Report No. 38, Measuring Hydraulic Conductivity for Use in Soil Surveys, March 1982, USDA, SCS.

Soil Survey Investigations Report 42, Soil Survey Laboratory Methods Manual, (Current Version), USDA, NRCS. http://soils.usda.gov/procedures/lmm/main.htm

Soil Survey Investigations Report 45, Soil Survey Laboratory Information Manual, 1995, USDA, NRCS
http://soils.usda.gov/soil_survey/nscd/lim/main.htm

SSURGO Data Users Guide, USDA, NRCS.
http://www.ftw.nrcs.usda.gov/ssur_data.html

STATSGO Data Users Guide, Miscellaneous Publication, 1991, USDA, SCS.

http://www.ftw.nrcs.usda.gov/stat_data.html

U.S. Department of Health, Education, and Welfare, Public Health Service, 1969 Manual of Septic Tanks, PHS Publication No. 526.

Part 601 - NATIONAL COOPERATIVE SOIL SURVEY ORGANIZATION

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Part 601 - NATIONAL COOPERATIVE SOIL SURVEY ORGANIZATION

601.00 Definition.

The National Cooperative Soil Survey (NCSS) is a nationwide partnership of federal, regional, state and local agencies; and private entities and institutions. This partnership works together to cooperatively investigate, inventory, document, classify, interpret, disseminate, and publish information about soils of the United States and its trust territories and commonwealths. The activities of the NCSS are carried out on national, regional, and state levels.

The Natural Resources Conservation Service (NRCS) is responsible for the leadership of soil survey activities of the U.S. Department of Agriculture, for the leadership and coordination of NCSS activities, and for the extension of soil survey technology to global applications. Additional information about the soil survey program is in the NRCS General Manual (http://policy.nrcs.usda.gov/) under Title 430, Part 402.

Primary federal agency NCSS participants include Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Department of Defense (DoD), Forest Service (FS), National Park Service (NPS), and Natural Resources Conservation Service (NRCS). Appendix A has a short description of the roles of these partners. In addition to these federal agency partners, there are numerous state and local partners participating in the NCSS. Information about the organization and responsibilities of partner agencies are contained in their policy documents.

601.01 NRCS Organization and Responsibilities.

This section provides information about the responsibilities of various offices within the NRCS as they pertain to the National Cooperative Soil Survey Program.

(a) NCSS Responsibilities of the MLRA Soil Survey Office (MLRA-SSO).

(1) updating soil surveys on a physiographic basis;
(2) assisting the state soil scientist in evaluating the needs for updating soil survey maps and data;
(3) managing the project soil survey of private and Native American lands within the assigned area;
(4) preparing annual work plans including schedules for completion of priorities identified in the project plan of operations for the area;
(5) providing on-the-job technical direction and training for soil survey project members;
(6) controlling the quality of all phases of the soil survey as specified in the Memorandum of Understanding (MOU) and project plan of operations;
(7) periodically reviewing all soil survey products developed by the office staff to ensure those products meet NCSS standards;
(8) ensuring that all soil survey products submitted for quality assurance review and certification have passed prior quality control inspections;
(9) making initial correlation decisions for the survey area using NCSS standards and supplemental guidance provided by the MLRA Regional Office (MO);
(10) conducting progressive soil correlation during the course of all soil survey activities;

(11) ensuring that all changes to map unit names and legends, and the reasons for the changes, are recorded in the National Soil Information System (NASIS);
(12) ensuring coordinated and joined soil survey products across political and physiographic boundaries in the survey area as defined in part 609.03;
(13) coordinating with NCSS partners responsible for soil survey of federal lands within the assigned area so that a coordinated and joined soil survey product is produced;
(14) assessing training needs of the MLRA-SSO staff and requesting training from the MO and the State Soil Scientist;
(15) preparing agendas, soil descriptions, lab data, maps, and other information needed for quality assurance reviews conducted by the MO;
(16) ensuring findings and recommendations identified in the MO quality assurance reviews are addressed and implemented in a timely manner;
(17) developing soil survey manuscripts that meet the NCSS standards as outlined in part 644;
(18) developing digital spatial information that meet the NCSS standards as outlined in part 647;
(19) preparing soil series descriptions;
(20) ensuring Official Soil Series Descriptions (OSDs) drafted or revised by the MLRA-SSO meet NCSS standards as outlined in part 614 and have passed the OSD Check Program prior to being submitted for processing;
(21) collecting soil performance data;
(22) identifying and planning soil survey investigations;
(23) preparing soil survey technical reports;
(24) compiling soil maps for technical reports;
(25) developing and maintaining the project soil database in NASIS;
(26) developing and implementing an active information program; and
(27) maintaining a safe working environment.

(b) NCSS Responsibilities of the Resource Soil Scientist.

(1) assisting the state soil scientist with the development, coordination, and maintenance of field office technical guides and soil interpretations;
(2) conducting onsite soils investigations according to agency authorities;
(3) evaluating and assisting field offices to maintain the official record copy of soil survey information and soil information systems;
(4) coordinating with the MLRA soil survey office and state office to make any needed changes in the official soil survey data;
(5) providing assistance in the use of soils information for the implementation of NRCS programs;
(6) providing interdisciplinary input to solve resource problems;
(7) assisting with special soil studies including collecting additional site and soil information on the performance and behavior of correlated soil map units;
(8) training NRCS staffs and the public to understand and utilize soil survey data and information;
(9) assisting the state soil scientist with the development and dissemination of soil information and in promoting soil survey; and
(10) assisting the state soil scientist to evaluate the adequacy of existing soil survey maps, data, and interpretations.

(c) NCSS Responsibilities of the State Soil Scientist.

(1) providing technical soil services to other staffs and leadership to resource soil scientists;
(2) developing cooperative relationships to enhance the funding, progress, use and understanding of soil surveys;
(3) serving as liaison to NCSS cooperators;

(4) hosting an annual meeting of state NCSS cooperators to plan and coordinate soil survey activities and technical soil services;
(5) periodically hosting the regional or national NCSS conference;
(6) documenting the needs for updating soil survey maps, data, and interpretations;
(7) establishing priorities for the MLRA Soil Survey Office project plans in cooperation with partners, other state soil scientists, the MO, and other stakeholders;
(8) assisting soil survey users in understanding and applying soil survey information;
(9) coordinating the development of localized soil interpretations;
(10) maintaining the Digital General Soil Map of the U.S.;
(11) marketing soil survey information;
(12) providing soils training to specialists in other disciplines;
(13) ensuring the technical content, coordination, and quality of soil information in the field office technical guides;
(14) providing soils input to all NRCS program activities;
(15) posting updated soil survey data to the soil data warehouse and data marts;
(16) assisting in national soil program initiatives;
(17) supplementing and distributing a state subset of the national soil information system data;
(18) providing to the responsible MO, layers desired for map finishing in a compiled or electronic format compatible with digital map finishing (these include such layers as hydrography, public land survey, roads, and recommended cultural features to be used in the survey);
(19) providing administrative and management support and guidance to the soil survey offices that they supervise;
(20) preparing digital files for general soil maps, index maps, soil legend and special features legend, geology maps, and block diagrams for use in manuscripts;
(21) submitting complete manuscripts that have passed a state quality control review to the MO;
(22) ensuring that findings and recommendations identified in the MO quality assurance reviews are addressed and implemented in a timely manner;
(23) providing leadership for identifying the need for new soil survey information and interpretations within the state; and
(24) providing leadership for the development of new soil survey applications, technology, and information delivery within the state.

(d) NCSS Responsibilities of the MLRA Regional Office (MO).

(1) providing leadership in the production and quality assurance of soil survey information including updating of soil surveys;
(2) developing a region-wide memorandum of understanding covering the entire MO region that outlines the responsibilities and specifications for conducting soil surveys in the region;
(3) providing coordination and quality assurance for all production soil survey and update activities and products, including all data collection, NASIS data population, interpretation, correlation, manuscripts; and map compilation, finishing, and digitizing; to ensure that all soil survey products meet NCSS standards;
(4) providing leadership in classifying, interpreting, correlating, and joining soils within and between MLRAs;
(5) planning and managing the MLRA Regional Office activities in cooperation with the state soil scientists, cooperators, and other stakeholders;
(6) coordinating with National Soil Survey Center soil scientists and other disciplines as appropriate to maintain and improve soil surveys;
(7) securing technical input and review from other disciplines into soil interpretations and technical reports;
(8) providing technical support and guidance to soil survey project offices;

(9) conducting quality assurance reviews to:
- (i) ensure that products developed by the MLRA-SSO have passed quality control inspections and meet NCSS standards,
- (ii) ensure that progressive correlation is being implemented and followed by the MLRA-SSO Staff,
- (iii) provide guidance to the MLRA-SSO Staff,
- (iv) identify training needs, as well as management and performance issues, and communicate those needs and concerns to the appropriate supervisor; and

(10) providing states with findings, recommendations, and commendations from quality assurance reviews;
(11) providing supplemental training in all aspects of soil survey operations as may be needed (beyond that provided by the Soil Survey Division) to soil survey office staffs through technical notes, on-site visits, workshops, and similar activities;
(12) providing quality assurance of all attribute data residing in NASIS, and the official series description (OSD) and soil classification (SC) databases;
(13) developing soil correlation documents for initial soil surveys;
(14) coordinating and maintaining soil series and soil property and interpretation databases;
(15) providing quality assurance of all OSDs developed or revised in the MO region;
(16) maintaining the national OSD and SC databases (where authority to edit and process OSD and SC data is delegated to a MLRA-SSO, the MO is responsible to assure the quality of this work);
(17) ensuring the development of seamless soil survey products across political and physiographic boundaries as defined in 609.03;
(18) providing MLRA-specific correlation guidelines on soil temperature and moisture regimes and their associated ecological zones and vegetation and any other MLRA-specific information;
(19) providing leadership for the coordinated collection of soil survey related soil characterization data and investigations in the MO region;
(20) providing leadership in collecting, analyzing, and interpreting soil performance and characterization data;
(21) providing technical quality assurance to soil survey technical reports and maps submitted for publication;
(22) editing, formatting, proofreading, and reviewing text and tables for soil survey technical reports;
(23) providing quality assurance of all spatial data developed in the MO Region;
(24) coordinating and providing quality assurance for the map finishing process;
(25) providing quality assurance of Soil Survey Geographic (SSURGO) database, and the Digital General Soil Map of the U.S. (STATSGO) database;
(26) coordinating proposed revisions to major land resource area boundaries with states and the NSSC; and
(27) assisting in coordination of regional or national NCSS conferences.

(e) NCSS Responsibilities of the National Technology Support Center Core Team Soil Scientist.

(1) providing assistance to states and MO offices in developing and implementing strategies to coordinate and deliver soil survey data and interpretations to meet specific program needs such as ranking systems and eligibility criteria for CRP and EQIP;
(2) providing technical assistance and guidance in developing interpretive criteria to meet state's specialized interpretive needs;
(3) developing soil science related policies and procedures and implementation strategies for maintaining and coordinating Field Office Technical Guides with primary emphasis on Section II;
(4) developing, maintaining, and enhancing soils-related aspects of conservation practice standards and quality criteria used in Field Office Technical Guides;

(5) collaborating with other discipline specialists to develop and maintain drainage guides, irrigation guides, and other technical references included in the Engineering Field Manual and other discipline specific technical guides;
(6) developing, reviewing, and recommending program policy;
(7) providing specific guidance to states and collaborating with others regarding detailed training in the application of soil survey data and interpretations to programs such as Farmland Protection Policy Act, Farm and Ranchland Protection Program, and Farm Bill programs;
(8) collaborating with others to provide training and guidance at all levels in the use, understanding, and appropriate application of soil survey information in program policy and environmental models;
(9) developing interpretive criteria, identifying data requirements, and coordinating delivery of data and interpretations to meet specific national program needs;
(10) providing technical expertise, and serves as Soil Survey Division representative to Agricultural Research Service, University research stations, and others in the use and application of soils and soil survey information in the development of environmental models such as RUSLE2, WEPS, WinPST, WEPP, and EPIC;
(11) promoting the use and integration of soil survey information in public and program policies;
(12) works with the Soil Quality Special Technology Development Team, NTSC and NRCS staffs, and others to anticipate and identify needs for soil survey data and interpretations to meet new and emerging programs and strategize technology transfer and training; and
(13) represents the Soil Survey Division and provides technical expertise to task forces, committees, and work groups dealing with natural resource issues such as air, water, and soil quality: and related legal, social, and policy concerns.

(f) NCSS Responsibilities of the National Cartography and Geospatial Center.

(1) acquiring imagery for soil mapping and technical reports;
(2) preparing maps and indices of aerial photography;
(3) preparing orthophotos for halftone reproduction and lithographic printing;
(4) providing a repository for geospatial data layers and distributing as needed;
(5) assisting the MLRA Regional Office to provide quality assurance of digital soils spatial data;
(6) providing guidance in the management of geospatial data;
(7) providing support for the integration of new geospatial technologies;
(8) providing the process, procedures, and the training to generate map finished products;
(9) providing photographic and reproduction materials for reports and soil survey management;
(10) preparing map materials for reproduction;
(11) assembling proof layouts for printing technical reports;
(12) preparing the final locator maps, block diagrams, general soil maps, and index to map sheets that are used in soil survey technical reports;
(13) distributing certified SSURGO data and the Digital General Soil Map of the U.S;
(14) acquiring, integrating, and delivering digital elevation data for soil survey application;
(15) assisting with the application of remote sensing to soil survey;
(16) providing global positioning system acquisition, evaluation, and training;
(17) providing geospatial web services (WMS), image map services (IMS), feature map services (FMS), and the Geospatial Gateway for soil survey data distribution and application; and
(18) providing training and assistance with geographic information systems (GIS).

(g) NCSS Responsibilities of the National Geospatial Development Center.

(1) promoting partnerships with educational institutions, private industry, and government agencies to research and develop technologies to enhance the production and utilization of soil information;
(2) addressing future soil information dissemination in partnership with the National Cartographic and Geospatial Center by developing technologies to support distribution; and
(3) implementing functional user-friendly applications by delivering them to the appropriate functional unit for their use.

(h) NCSS Responsibilities of the National Soil Survey Center.

(1) providing leadership to the development of policies, guidelines, standards, and procedures for all technical phases of NCSS work;
(2) maintaining and improving the scientific basis for the NCSS program;
(3) maintaining national soil survey standards -- included in the National Soil Survey Handbook, the Soil Survey Manual, Soil Taxonomy, Soil Survey Laboratory Methods Manual, and other topical handbooks for mapping, classification, interpretation, investigation, laboratory analysis, and data management;
(4) providing leadership for the effective integration of soil survey technical standards and principles in the development and maintenance of spatial and tabular information systems;
(5) assisting international, national, MO, state, and soil survey office staffs in soil survey activities;
(6) coordinating with National Employee Development Center to plan and deliver training for the Soil Survey Division including training in soil survey procedures, soil classification, pedology, geomorphic principles and application, interpretations, investigations, soil survey project management, technical soil services, and soil survey data management;
(7) supplementing basic soil survey information with laboratory and field data on properties and behavior of soils; and
(8) providing liaisons to each of the NCSS regional conferences.

(i) NCSS Responsibilities of the National Headquarters.

(1) formulating national policies regarding the soil survey program;
(2) formulating policy regarding the integration of technical soil services within NRCS and with other agencies;
(3) representing NRCS agency interests to the NCSS;
(4) providing leadership for the federal part of NCSS;
(5) chairing and coordinating the NCSS and its activities; and
(6) developing and maintaining relationships and contacts with NCSS cooperators.

Appendix 601-1. Primary Federal Partners.

This appendix includes a brief description of the role of the five primary federal partners in the NCSS. Descriptions were prepared in 2006 by representatives of each agency. The most current information is contained in each agency's own policy documents.

Bureau of Indian Affairs (BIA)

The BIA is the primary contact for soil surveys on the 93.7 million acres of Native American lands. Soil surveys are primarily at 1:24,000 scale to support land management decision making processes. Soil surveys are needed to meet needs for farming, community planning, land development, and grazing and forest management. Soil survey and ecological site data are necessary to accomplish land health assessments, grazing permit renewal, energy and mineral permitting and leasing, restoring natural fire processes, restoring health of the land, maintaining clean water and air, and invasive plant control. Soil information is fundamental in assessing soil capabilities, limitations, and vulnerability to degradation and loss of capacity to sustain the health of the land. Native American lands are considered private lands and, as such, NRCS has the responsibility to complete soil surveys on Native American lands. Soil surveys are completed in conjunction with BIA soil scientists and other staff.

Bureau of Land Management (BLM)

The BLM manages approximately 261 million surface acres of public lands, located primarily in 12 Western States. The mission of the BLM is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. The BLM-administered lands include a diverse mosaic of grassland, shrub land, forest, desert, arctic and alpine ecosystems on extensive landscapes that can range from nearly level playas to steep, rugged mountains. These landscapes and ecosystems contain a wide variety of soils with diverse properties that can significantly affect use and management. The BLM manages a wide variety of resources and uses including energy and minerals, livestock forage, fish and wildlife habitat, timber, wild horse and burro populations, watershed values, wilderness and recreation areas, and cultural and other natural heritage values. The BLM administers public lands within a framework of numerous laws and regulations, including FLPMA, NEPA, and state water quality laws. Soils are one of the most fundamental natural resources on public lands. Soils sustain the health, diversity, and productivity of the land. Soil quality and health are the driving forces that determine these factors.

Soil surveys are primarily at 1:24,000 scale to support land management decision making processes. Soil survey and ecological site data are necessary to accomplish rangeland health assessments, grazing permit renewal, energy and mineral permitting and leasing, restoring natural fire processes, restoring health of the land, maintaining clean water and air, and invasive plant control. Soil information is fundamental in assessing soil capabilities, limitations, and vulnerability to degradation and loss of capacity to sustain the health of the land. All public land activity that disturbs the soil benefits from the information and interpretations provided in soil surveys. Most soil and ecological mapping on public land has been accomplished via reimbursable agreements with the NRCS.

Department of Defense (DoD)

DoD manages about 50 million acres divided up into five main agencies. The Army has about 17 million acres of mission land, the Air Force has about 9 million acres, the Navy has about 2 million acres, the Marines have about 1 million acres, and the Army Corps of Engineers has about 15 million acres. The remainder is divided up by smaller agencies.

DoD has two missions on its installations. The first mission is to train soldiers, marines, airmen, and sailors in conditions as close as possible to those they may have to fight in. The second mission is managing for the conservation of natural resources. Managing for conservation of natural resources allows for the first mission.

The Sikes Act, as amended, requires each component Service (Army, Air Force, Navy, and Marines) to have an Integrated Natural Resources Management Plan (INRMP) for each installation and/or training site that has significant natural resources. The INRMP describes the installation's natural resources and its management strategy for sustaining them while supporting the installation's military mission. The Department of Defense is interested in focusing its efforts on its mission training lands.

Each Service's natural resources management implementing guidelines require a soil planning level survey as part of an installation's INRMP. Each Service either names NRCS as the source from which to obtain soils data or requires that the soil survey be done to NCSS standards and procedures. Each installation's mission normally dictates the level of detail needed. The Army's standard is a 1:12,000 soil survey to support installations where millions of miles of vehicle (from ATVs through main battle tanks) traffic and other land intensive mission training takes place. On those installations that DoD is closing, clean-up requirements often need Order 2 soil surveys to understand the fate and transport of chemicals and constituents of concern. Installations needing a soil survey enter into an agreement with the NRCS of the state(s) the installation is located in. At the installation's request, the soil survey may be restricted from public access due to national security concerns.

Forest Service (FS)

The national forests (at first called forest reserves) began with the Forest Reserve Act of 1891, which allowed the President to establish forest reserves from timber-covered public domain land. National forests and grasslands encompass 193 million acres of land. There are 155 national forests and 20 grasslands. Congress established the Forest Service to provide quality water and timber for the Nation's benefit. The Forest Service manages national forests for multiple uses and benefits and for the sustained yield of renewable resources such as water, forage, wildlife, wood, and recreation. Multiple uses means managing resources under the best combination of uses to benefit the American people while ensuring the productivity of the land and protecting the quality of the environment.

The National Forest System uses soil resource inventories and terrestrial ecological unit inventories to develop land and resource management plans as well as project plans. The Forest Service has pursued an ecological approach to land stewardship. This evolution has increased the need for soil resource inventories to collect and classify vegetation data in conjunction with progressive inventories. Soil surveys in the eastern U.S. have been completed primarily through agreements with NRCS. In the western states, soil surveys are typically completed by Forest Service staff.

National Park Service (NPS)

The National Park Service acts as steward for natural resources on nearly 85 million acres of public land.

Management Policies and Guidelines for soil resource management are contained in NPS-77 "Natural Resources Management". The NPS Management Policies states: The NPS will actively seek to understand and preserve the soil resources of parks and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources. The NPS Soil Inventory and Monitoring Program is acquiring appropriate, detailed geospatial soil databases which will define the distribution of soil types; determine their physical, chemical, and biological characteristics; and provide interpretations needed to assess soil capabilities, limitations, and vulnerabilities to degradation, as well as promoting a soil conservation ethic and supporting soil resources management, vital signs monitoring, ecological restoration activities, and facilities development decisions within the agency.

Soil management objectives are as follows:

(a) Preserve intact, functioning, natural systems by preserving native soils and the processes of soil genesis in a condition undisturbed by humans.

(b) Maintain significant cultural objects and scenes by conserving soils consistent with maintenance of the associated historic practices, and by minimizing soil erosion to the extent possible.

(c) Protect property and provide safety by ensuring that developments and their management take into account soil limitations, behavior, and hazards.

(d) Minimize soil loss and disturbance caused by special use activities and ensure that soils retain their productivity and potential for reclamation. The NPS typically works with NRCS, via Interagency Agreements, to support dedicated soil survey crews in strategic locations to map NPS lands as well as refine and/or develop ecological site descriptions to meet agency needs.

Part 602 - NATIONAL COOPERATIVE SOIL SURVEY CONFERENCES

CONTENTS

Part 602 - NATIONAL COOPERATIVE SOIL SURVEY CONFERENCES

602.00 Definition.

The National Cooperative Soil Survey (NCSS) coordinates technically and operationally at National, regional, and State levels. Its activities relate to the technology for the collection, management, and presentation of information about the properties, patterns, and responses of soils and to other joint concerns, such as training and coordinated research and operations. Workshops, meetings, and conferences at each level discuss and resolve concerns, proposals, and recommendations for the cooperative soil survey.

(a) The National Cooperative Soil Survey Conference.
The national conference primarily discusses subjects of national concern to the NCSS. The Director, Soil Survey Division, Natural Resources Conservation Service (NRCS), calls the conference in odd-numbered years after consulting with the conference steering committee. Attendees to the conference include national representatives of cooperating agencies and institutions. The Director invites other interested foreign and domestic groups and individuals and particularly principal users of soil surveys to participate. NRCS publishes the proceedings of the conference and distributes copies to the cooperators in the NCSS. The conference bylaws specify the objectives, membership, and committees. Refer to Exhibit 602-1 for the Bylaws of the National Cooperative Soil Survey Conference.

(b) The NCSS Regional Conferences.
The NCSS regional conferences primarily discuss subjects of regional concern. Each region convenes a soil survey conference in even-numbered years. The four regions correspond to the Agricultural Experiment Station regions and are the North Central, Northeastern, Southern, and Western. State and regional soil survey leaders, some national leaders, and other invited persons attend the conference. The conference steering committee publishes the conference proceedings and distributes copies to regional NCSS cooperators and others. The conference bylaws specify the objectives, membership, and committee responsibilities.

(c) NCSS State Conferences.
The NCSS state conferences primarily discuss subjects of state concern. The NRCS state soil scientist annually convenes a state conference. Attendees include cooperators and others who contribute to NCSS activities at the state level and principal users of soil survey information. Working agreements govern activities of the NCSS within the state.

(d) Joint Regional or State Conferences.
Joint regional or state conferences between two or more regions or states can be held with the agreement of the participants involved.

Exhibit 602-1 Bylaws of the National Cooperative Soil Survey Conference.

Article I. Name

Section 1.0 The name of the Conference shall be the National Cooperative Soil Survey (NCSS) Conference.

Article II. Objectives

Section 1.0 The objective of the Conference is to contribute to the general human welfare by promoting the use of soil resource information and by developing recommendations for courses of action, including national policies and procedures, related to soil surveys and soil resource information.

Article III. Membership and Participants

Section 1.0 Permanent chair of the Conference is Director, Soil Survey Division, NRCS.

Section 2.0 Permanent membership of the Conference shall consist of:

Section 2.1.1 Members of the steering committee,

Section 2.1.2 Two State members appointed by each of the four regional conferences and six NRCS soil survey staff leaders, to include representatives of the National Headquarters, National Soil Survey Center, and Soil Survey Staff representing each of the four NCSS Regions, as determined by the Director, Soil Survey Division, NRCS.

Section 2.1.3 Individuals designated by the Federal agencies listed in Appendix A.

Section 3.0 Participants of the Conference shall consist of:

Section 3.1.1 Permanent members,

Section 3.1.2 Individuals invited by the Steering Committee.

Article IV. Regional Conferences

Section 1.0 Regional Conferences are organized in the northeast, north-central, southern, and western regions of the United States.

Section 2.0 Regional Conferences determine their own membership requirements, officers, and number and kind of meetings.

Section 3.0 Each Regional Conference adopts its own purpose, policies, and procedures, provided these are consistent with the bylaws and objectives of the NCSS Conference.

Section 4.0 Each Regional Conference shall publish proceedings of regional meetings.

Article V. Executive Services

Section 1.0 The National Headquarters Soil Survey staff of the Natural Resources Conservation Service (NRCS) shall provide the Conference with executive services.

Section 1.1 The Soil Survey staff, NRCS, shall:

Section 1.1.1 Carry out administrative duties assigned by the Steering Committee.

Section 1.1.2 Distribute draft committee reports to participants.

Section 1.1.3 Issue announcements and invitations.

Section 1.1.4 Prepare and distribute the program.

Section 1.1.5 Make arrangements for lodging, food, meeting rooms, and, local transportation for official functions.

Section 1.1.6 Provide a recorder.

Section 1.1.7 Assemble and distribute the proceedings.

Section 1.1.8 Provide publicity.

Section 1.1.9 Maintain the Conference mailing list.

Section 1.1.10 Maintain a record of all Conference proceedings; proceedings of Regional Conference meetings; and a copy of each Regional Conference's purpose, policies, and procedures.

Article VI. Steering Committee

Section 1.0 The Conference shall have a Steering Committee.

Section 1.1 The steering committee shall consist of:

Section 1.1.1 The Director, Soil Survey Division, NRCS, is permanent chair and is responsible for all work of the Steering Committee.

Section 1.1.2 The U.S. Forest Service Soil Survey Leader.

Section 1.1.3 The Bureau of Land Management Senior Soil Scientist.

Section 1.1.4 Four Agricultural Experiment Station Soil Survey Leaders, one from each respective Regional Conference. This normally is the State representative that will be chair or vice chair of the next Regional Conference.

Section 1.1.5 Six NRCS soil survey staff leaders, to include representatives of the National Headquarters, National Soil Survey Center, and Soil Survey Staff representing each of the four NCSS Regions, as determined by the Director, Soil Survey Division, NRCS.

Section 1.1.6 A designated representative of the National Society of Consulting Soil Scientists, Inc., as determined by the Society representing the private sector.

Section 1.1.7 A representative of the 1890 College from the vicinity of the next conference recommended by the Conference Chair.

Section 1.1.8 A representative of the Tribal College from the vicinity of the next conference recommended by the Conference Chair.

Section 1.1.9 A representative of the National Association of State Conservation Agencies.

Section 2.0 The Steering Committee shall select a vice chair for a 2-year term. The vice chair acts for the chair in the chair's absence or disability or as assigned.

Section 3.0 The Steering Committee shall formulate policy and procedure for the Conference.

Section 4.0 The Steering Committee shall:

Section 4.1.1 Determine subjects to be discussed.

Section 4.1.2 Determine committees to be formed.

Section 4.1.3 Select committee chair and obtain their approval and that of their agency for participation.

Section 4.1.4 Assign charges to the committee chairs.

Section 4.1.5 Recommend committee members to committee chairs.

Section 4.1.6 Determine individuals from the United States or other countries with soil science or related professional interest to be invited to participate.

Section 4.1.7 Determine the place and date of the Conference.

Section 4.1.8 Organize the program and select the presiding chairs for the sessions.

Section 4.1.9 Assemble in joint session at least once during each Conference to conduct business of the Conference.

Section 5.0 Steering Committee work will normally be done by correspondence and telephone communication.

Section 6.0 Fifty percent of the Steering Committee shall constitute a quorum for the transaction of business. Items shall be passed by a majority of members present or corresponding. The chair does not vote except in the case of a tie vote.

Article VII. Meetings.

Section 1.0 A meeting of the Conference normally shall be held every 2 years in odd-numbered years for the presentation and discussion of committee reports; exchange of ideas; and transaction of business. It shall consist of committee sessions and general sessions. Opportunity shall be provided for discussion of items members may wish to have brought before the Conference.

Section 2.0 The time and place of meetings shall be determined by the Steering Committee.

Section 3.0 The Steering Committee is responsible for planning, organizing, and managing the conference.

Section 4.0 The Steering Committee shall meet immediately after the conference to summarize recommendations and propose actions to be taken.

Section 5.0 Meetings of the Steering Committee, other than at the conference, may be called with the approval of the Steering Committee.

Article VIII. Committees

Section 1.0 The committees of the Conference shall be determined by the Steering Committee. Permanent or standing committees, ad hoc committees, and task force groups are considered to be committees of the Conference. The Steering Committee shall select committee chairs.

Section 2.0 Committee members shall be selected by the committee chairs. Committee members shall be selected after considering Steering Committee recommendations, Regional Conference recommendations, individual interests, technical proficiency, and continuity of the work. They are not limited to members of the National Cooperative Soil Survey.

Section 3.0 Each committee commonly conducts its work by correspondence among committee members. Committee chairs shall provide their committee members with the charges as assigned by the Steering Committee and procedure for committee operation.

Section 4.0 Each committee chair shall send copies of a draft committee report to the Steering Committee prior to the Conference.

Section 5.0 Each committee shall report at the Conference.

Article IX. Amendments

Section 1.0 The bylaws may be amended by ballot with a majority vote of the permanent members. An amendment shall, unless otherwise provided therein, be effective immediately upon adoption and shall remain in effect until changed.

APPENDIX A

MEMORANDUM OF UNDERSTANDINGS WITH THE NATURAL RESOURCES CONSERVATION SERVICE IN THE NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE:

--Bureau of Indian Affairs, U.S. Department of the Interior
--Bureau of Land Management, U.S. Department of the Interior
--Bureau of Reclamation, U.S. Department of the Interior
--Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture
--Defense Mapping Agency, U.S. Department of Defense
--Economics and Statistics Service, U.S. Department of Agriculture
--Environmental Protection Agency
--Farm Services Agency, U.S. Department of Agriculture
--Forest Service, U.S. Department of Agriculture
--National Agricultural Statistics Service, U.S. Department of Agriculture
--National Institute of Standards and Technology, U.S. Department of Commerce
--National Association of State Conservation Agencies
--National Oceanic and Atmospheric Administration, U.S. Department of Commerce
--National Park Service, U.S. Department of the Interior
--National Society of Consulting Soil Scientists, Inc.
--Office of Territorial Affairs, U.S. Department of the Interior
--Tennessee Valley Authority (quasi Federal)
--U.S. Army Corps of Engineers, U.S. Department of Defense
--U.S. Fish and Wildlife Service, U.S. Department of the Interior
--U.S. Food and Drug Administration, U.S. Department of Health and Human Services
--U.S. Geological Survey, U.S. Department of the Interior

Exhibit 602-2 Bylaws of the Western Regional Cooperative Soil Survey Conference
(Update June 2004)

Article I - Name

Section 1.0 *Conference Name*

The name of the conference shall be the Western Regional Cooperative Soil Survey Conference. It is formed of and represents the area within the state boundaries of the following thirteen western states and U S Territory: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Nevada, New Mexico, Montana, Oregon, Pacific Basin, Utah, Washington, and Wyoming.

Article II - Objectives

Section 2.0 *Objectives and Purposes*

The objectives and purposes of the Western Regional Cooperative Soil Survey Conference are to bring together Western States representatives of the National Cooperative Soil Survey for discussion of technical and scientific questions. Through the actions of committees and conference discussions, experience is summarized and clarified for the benefit of all; new areas explored; procedures are synthesized; and ideas are exchanged and disseminated. The conference also functions as a clearinghouse for recommendations and proposals received from individual members and State Conferences for transmittal to the National Cooperative Soil Survey Conference. The conference promotes the use of soil resource information by others and develops recommendations for courses of action, including national policies and procedures, that relate to making soil surveys and using soil resource data and information.

Article III - Membership And Participants

Section 3.0 *Permanent Membership*

Permanent membership of the conference shall consist of:

1. National Leader for Soil Taxonomy and Standards who serves as Executive Secretary for Conference Steering Committee
2. NRCS State Soil Scientists/MLRA Leaders
3. Representatives from Western State Experiment Stations and Land Grant Universities
4. Regional Soil Scientists from the 7 Western U S Forest Service Regions – Northern Region, Rocky Mountain Region, Southwest Region, Intermountain Region, Pacific Southwest Region, Pacific Northwest Region, and Alaska Region
5. USDI, Bureau of Land Management (BLM) State Soil Scientist or State Soil Liaison from 11 Western States (Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon/Washington, Utah, and Wyoming)
6. Representatives from 7 Western Regions of USDI, Bureau of Indian Affairs (BIA) Regions – Alaska Region, Navajo Region, Northwest Region, Pacific Region, Rocky Mountain Region, Southwest Region, and Western Region.
7. NCSS Representative from the USDI National Park Service (NPS)
8. President-elect or delegated representative from the National Society of Consulting Soil Scientists (NSCSS)
9. A representative from the National Congress of American Indians
10. Program Manager for Land Suitability and Water Quality, USDI, Bureau of Reclamation (BOR)
11. A Representative from USDI Corps of Engineers (COE)

Section 3.1 *Associate Membership*

Invitations may be extended to a number of other individuals to participate in committee work or for a specific conference or conferences. A representative from the NRCS National Cartographic and Geospatial Center (NCGC) and a representative from the NRCS Information Technology Center (ITC) shall be associate conference members. Any soil scientist, technical specialist, or other individual of any local, state, or federal agency or interest group whose participation will benefit particular objectives or projects of the conference may be invited to participate. Any permanent member of the conference may invite one additional participant. If a permanent member wishes to invite more than one guest (or associate member), the request should be cleared through the Chair or Vice-Chair of the conference, or the Chair of the Steering Committee. Names of all associate members of a specific conference should be provided to the conference Chair.

Article IV - Conference Officers

Section 4.0 *Conference Officers*

A Chair, Vice-Chair and Secretary of the conference are elected to serve for a two-year term. Their tenure runs from the end of a conference to the end of the following conference. Elections are held during the biennial business meeting. Conference officers shall be from the state hosting the next conference. Officers should rotate among the agencies. That is to say, the Chair-elect should represent a different agency than the past Chair. Similarly, the Vice-Chair and Secretary must be of different agencies than their predecessors.

Section 4.0.1 *Responsibilities of the Chair* (specific tasks may be delegated to the Vice-Chair):

1. Plans and manages the biennial conference.
2. Serves as a steering committee member.
3. Presides at the conference business meeting.
4. Issues conference announcements and invitations.
5. Organizes the conference program.
6. Selects presiding Chair for the various sessions.
7. Develops the conference agenda, and has copies of the agenda prepared and distributed.
8. Make necessary arrangements for lodging accommodations for conference participants, for food functions, if any, for meeting rooms (including committee rooms), for a field trip, and for local transport for other official functions.
9. Assembles, reproduces, and distributes the Conference Proceedings.
10. Provides for appropriate conference publicity.
11. Arranges for conference guest speakers.
12. Presides over the conference business meeting.

Section 4.0.2 *Responsibilities of the Vice-Chair*

1. Serves as a steering committee member.
2. Acts for the Conference Chair in the Chair's absence or disability.
3. Assists the Conference Chair in carrying out his/her responsibilities, and performs other duties as assigned by the Conference Chair.
4. Compiles and maintains the conference mailing list.

Section 4.0.3 *Responsibilities of the Secretary*

1. Maintains conference business meetings minutes and other conference meetings minutes as assigned by the Conference Chair.
2. Obtains copies of all committee reports and papers presented at the conference and makes copies available to all conference members.
3. Compiles the conference proceedings and assists the Chair in their duplication and distribution.

Article V - Meetings

Section 5.0 *Time of Meetings*

The conference convenes every two years, in even numbered years. It convenes the third week in June, unless a different date is agreed to by a majority of permanent conference members at the previous conference.

Section 5.1 *Location of Meetings*

The conference will be held on a rotational basis throughout the region according to the following schedule. States may trade years to host the conference for good cause and upon approval by a majority vote of the conference members at the business meeting preceding the next conference.

Year	State
2006	Utah
2008	Washington
2010	Nevada
2012	California
2014	Oregon
2016	Alaska
2018	Arizona
2020	Idaho
2022	Montana
2024	New Mexico
2026	Hawaii
2028	Colorado
2030	Wyoming

Article VI- Committees

Section 6.0 *Kinds and functions of Committees*

The conference will have permanent standing, ad hoc, and special task force committees. Duly constituted official committees accomplish most conference work. The kinds of committees and their charges are determined by the Steering Committee, based on the recommendations of the conference members. Committee members are appointed by the Steering Committee after first determining the interests of conference members. Each committee shall make an official report at the designated time at each biennial conference. Committee reports shall be duplicated and copies distributed as follows:

1. One copy to each permanent member (whether present or not) and to each participant in the conference.
2. One final copy to the Conference Secretary for inclusion in the conference proceedings. This copy will include all revisions approved by the conference.

Much of the work of committees will, of necessity, be conducted by correspondence during the interval between conferences.

Section 6.1 *Committee Structure*

Each committee has a Chair. A Secretary, or recorder, may be elected by the committee or appointed by the Chair, if necessary. Committee Chairs are selected by the Steering Committee or are elected by the conference. Chairs for the standing committees should rotate at the conclusion of each conference. Chairs are recommended by the committees and approved by the Steering Committee at least 4 months prior to the conference. Term of responsibility starts at the end of one conference and finishes with end of next. The Committee Chairs are responsible for prompt submission of their reports to the Chair of the Steering Committee who will duplicate and distribute the reports. This should be done prior to the beginning of the conference.

Section 6.1.1 *Committee Chair Responsibilities*

Committee Chairs are charged with the responsibility of initiating and carrying forward this work. They shall provide their committee members with the charges as directed by the Steering Committee and with additional instructions they deem necessary to complete the committee charge(s). Committee Chairs should initiate committee work at the earliest possible date to assure completion by the next scheduled conference.

Committee Chairs shall also give a verbal summary of committee actions/recommendations at designated times during the conference.

Section 6.2 *Permanent Standing Committees*

Permanent standing committees are established by the By-laws of the National Cooperative Soil Survey Conference as contained in the NSSH Part 602.00 and Exhibit 602-1.

- Soil Survey Standards
- Soil Taxonomy
- Research Needs
- Applied Technology

Section 6.2.1 *Conference Steering Committee*

The Conference Chair will also serve as the Chair of the Conference Steering Committee. The National Leader for Soil Classification and Standards will serve as the permanent Executive Secretary of the Steering Committee. The Steering Committee formulates policy on conference membership and participation. Final approval or disapproval of policy changes is by vote, during the biennial business meeting of the conference. The Steering Committee will assure that there is a balance among states and among agencies or each committee - that is to say that no one state or agency will dominate any single committee. The Conference Steering Committee shall consist consists of the following five (5) members:

1. Conference Chair
2. Conference Vice-Chair.
3. Conference Secretary
4. Executive Secretary
5. Past conference Chair

Section 6.2.2 *Responsibilities of the Conference Steering Committee:*

Conference Steering Committee responsibilities include but are not limited to:

1. Steering Committee Chair will call a meeting of the committee about 1 year prior to the conference to plan the meeting agenda and establish Conference Committees and develop committee charges
2. Formulate statements of conference policy
3. Formulate committee charges as recommended by the conference.
4. Select committee Chair and committee members as recommended by the conference.
5. Review conference activities and develop an executive summary of conference recommendations.
6. Send applicable conference recommendations to the Steering Committee Chair of the National Cooperative Soil Survey Conference.
7. Send applicable conference recommendations to the soil survey leaders of appropriate agencies for consideration and possible implementation.
8. Establish and maintain liaisons between the conference and:
   - The National and other Regional Conferences
   - State Conservationists of 13 Western States and Pacific Basin

- West Regional Soil Consortium
- Directors of the Western Experiment Stations
- National Congress of American Indians
- State, Regional, and National Offices of NRCS, US Forest Service, Bureau of Indian Affairs, Bureau of Land Management, National Park Service, American Indian Tribes, and National Society of Consulting Soil Scientists
- NRCS Institutes and Centers
- Other committees or work groups associated with the conference
- Others as identified by the Steering Committee

9. Shall meet immediately after the conference to summarize recommendations and propose actions to be taken.

At least sixty percent of the Conference Steering Committee shall constitute a quorum for the transaction of business. Items shall be passed by a majority of members present. The Chair does not vote except in the case of a tie vote.

Section 6.3 *Ad hoc Committees*
Ad hoc committees may be established by the Steering Committee as needed to meet specific needs and/or goals.

Section 6.4 *Special Task Force Committees*
Special task force committees may be established by the Steering committee as needed to meet specific needs and/or goals.

Article VII - Conference Advisors

Section 7.0 *Conference Advisors*
Conference advisors are invited to the conference and shall act in an advisory capacity to assist in items related to agency line and policy. Advisors to the conference are the State Conservationist (STC) of the host state, or as selected by the conference, the Experiment Station Director for the host state, or as selected by the conference, a Forest Service Regional Forester and a BLM State Director as selected by the conference.

Article VIII - Historical Records

Section 8.0 *Conference Historical Records*
The Executive Secretary of the Conference Steering Committee will maintain a permanent, cumulative file of conference programs, correspondence, committee reports, proceedings, by-laws and other material generated by or related to the conference..

Article VIII - Amendments

Section 9.0 *Amendments*
Any part of these by-laws may be amended for purposes, policy, and procedures at any time by ballot with a majority vote of the permanent membership. An amendment shall, unless otherwise provided therein, be effective immediately upon adoption and shall remain in effect until changed or deleted.

Exhibit 602-3 By-laws of the Northeastern Cooperative Soil Survey Conference (Revised May, 2006)

ARTICLE I - NAME

Section 1.0

The name of the Conference shall be the Northeast Cooperative Soil Survey Conference.

ARTICLE II - PURPOSE

Section 1.0

The purpose of the Northeast Cooperative Soil Survey Conference is to bring together representatives of the National Cooperative Soil Survey in the northeastern states for discussion of technical and scientific questions. Through the actions of committees and conference discussions, experience is summarized and clarified for the benefit of all; new areas are explored; procedures are synthesized; and ideas are exchanged and disseminated. The conference also functions as a clearing house for recommendations and proposals received from individual members and state conferences for transmittal to the National Cooperative Soil Survey Conference.

ARTICLE III - PARTICIPANTS

Section 1.0

Permanent participants of the conference are the following:

Section 1.1

The NRCS state soil scientist responsible for each of the 13 northeastern states: Connecticut, Delaware, Maine, Maryland (also representing the District of Columbia), Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Vermont, and West Virginia.

Section 1.2

The experiment station or university soil survey leader(s) of each of the 13 northeastern states.

Section 1.3

National Leader for Investigations or as assigned by the NRCS Director of the Soil Survey Division.

Section 1.4

NRCS, MLRA Office (MO) 12, 13, and 14 Team Leaders

Section 1.5

Lead Soil Scientist Eastern Region Technical Center

Section 1.6

A representative from the NRCS National Cartographic and Geospatial Center (NCGC)

Section 1.7

Three representatives from the soils staff of the USDA Forest Service as follows:

1. One from the Eastern Region, National Forest System
2. One from the Southern Region, National Forest System
3. One from the Northeastern Area, State and Private Forestry

Section 2.0

On the recommendation of the Steering Committee, the Chair of the Conference may extend invitations to a number of other individuals to a number of other individuals to participate in committee work and in the conference. Any soil scientist or other technical specialists whose participation is helpful for particular objectives or projects of the conference may be invited to attend.

ARTICLE IV - ORGANIZATION AND MANAGEMENT

Section 1.0 Steering Committee

A Steering Committee assists in the planning and management of biennial meetings, including the formulation of committee memberships and selection of the committee chair and vice-chair.

Section 1.1 Membership

The Steering Committee consists of the following four members:

1. National Leader for Investigations or as assigned by the NRCS Director of the Soil Survey Division (Steering Committee chair)
2. The conference chair
3. The conference vice-chair
4. The past conference chair

The Steering Committee may designate a conference chair and vice-chair if the persons are unable to fulfill their obligations.

Section 1.2 Meetings and Communications

A planning meeting is to be held about one year prior to the conference. Additional meetings may be scheduled by the chair if the need arises.

Most of the committee's communications will be in writing. Copies of all correspondence between members of the committee shall be sent to the chair.

Section 1.3 Authority and Responsibilities

Section 1.3.1 Conference Participants

The Steering Committee formulates policy on conference participants, but final approval or disapproval of changes in policy is by consensus of the participants.

The Steering Committee makes recommendations to the conference for extra and special participants in specific conferences.

Section 1.3.2 Conference Committees and Committee Chair

The Steering Committee formulates the conference committee membership and selects the committee chair and vice-chair.

The Steering Committee is responsible for the formulation of committee charges.

Section 1.3.3 Conference Policies

The Steering Committee is responsible for the formulation of statements of conference policy. Final approval of such statements is by consensus of the conference participants.

Section 1.3.4 Liaison

The Steering Committee is responsible for maintaining liaison between the regional conference and

1. The Northeastern Experiment Station Directors.
2. The East Region State Conservationists, NRCS.
3. Director, Soil Survey Division of the Natural Resources Conservation Service.
4. Regional and national offices of the U.S. Forest Service and other cooperating and participating agencies, and
5. The National Cooperative Soil Survey Conference.

Section 1.4

Responsibilities of the Steering Committee Chair are:

Section 1.41

Call a planning meeting of the Steering Committee about one year in advance of, and, and if possible, at the place of the conference to plan the agenda.

Section 1.4.2

Develop with the Steering Committee the first and final drafts of the conference's committees and their charges.

Section 1.4.3

Send committee assignments to committee members. The committee assignments will be determined by the Steering Committee at the planning meeting. The proposed chair and vice-chair of each committee will be contacted personally by the conference chair or vice-chair and asked if they will serve prior to final assignments. NRCS people will be contacted by an NRCS person and experiment station people will be contacted by an experiment station person.

Section 1.4.4

Compile and maintain a conference mailing list that can be copied on mailing labels.

Section 1.4.5

Serve as a member of the editorial board of the Northeast Cooperative Soil Survey Journal.

Section 2.0 Conference Chair and Vice-Chair

An experiment station representative and an NRCS state soil scientist alternate as conference chair and vice-chair. This sequence may be altered by the steering committee for special situations. The conference chair and vice-chair will serve a two-year term. The conference chair and vice-chair are chosen following the selection of a place for the next meeting and are from the state where the meeting is to be held.

Section 2.1

Responsibilities of the conference chair include the following:

Section 2.1.1

Function as chair of the biennial conference.

Section 2.1.2

Planning and management of the biennial conference.

Section 2.1.3

Function as a member of the Steering Committee.

Section 2.1.4

Send out a first announcement of the conference about 3/4 year prior to the conference.

Section 2.1.5

Send written invitations to all speakers or panel members and representatives from other regions. These people will be contacted before hand by phone or in person by various members of the Steering Committee.

Section 2.1.6

Send out written requests to experiment station representatives to find out if they will be presenting a report at the conference.

Section 2.1.7

Notify all speakers, panel members, and experiment station representatives in writing that a brief written summary of their presentation will be requested after the conference is over. This material will be included in the conference's proceedings.

Section 2.1.8

Preside over the conference.

Section 2.1.9

Provide for appropriate publicity for the conference.

Section 2.1.10

Preside at the business meeting at the conference.

Section 2.1.11

Serve as a member of the editorial board of the Northeast Cooperative Soil Survey Journal.

Section 2.2

Responsibilities of the conference vice-chair include the following:

Section 2.2.1

Function as Program Chair of the biennial conference.

Section 2.2.2

Serve as a member of the Steering Committee.

Section 2.2.3

Act for the chair in the chair's absence or disability.

Section 2.2.4

Develop the program agenda of the conference.

Section 2.2.5

Make necessary arrangements for lodging accommodations for conference members, for food functions, for meeting rooms, including committee loans, and for local transport on official functions. Notify all persons attending the meeting of the arrangement for the conference (rooms, etc.) included in the last mailing will be a copy of the agenda.

Section 2.2.6

Compile and distribute the proceedings of the conference.

Section 2.27

Serve as a member of the editorial board of the Northeast Cooperative Soil Survey Journal.

Section 3.0 Post Conference Chair

The primary responsibility of the past conference chair is to provide continuity from conference to conference. Additional responsibilities include the following:

Section 3.1

Serve as a member of the Steering Committee.

Section 3.2

Assist in planning the conference.

Section 3.3

Serve as the editor of the Northeast Cooperative Soil Survey Journal. This responsibility encompasses gathering information with the other editorial board members, printing the Journal, and distributing it.

Section 4.0 Administrative Advisors

Administrative advisors to the conference consist of the NRCS Regional Assistant Chief, East or their designee, Director of the NSSC, and the chair of the NE Agricultural Experiment Station Directors or their designated representatives.

ARTICLE V - TIME AND PLACE OF MEETINGS

Section 1.0

The conference convenes every two years, in even-numbered years. The date and location will be determined by the Steering Committee.

ARTICLE VI – CONFERENCE COMMITTEES

Section 1.0

Most of the work of the conference is accomplished by duly constituted committees.

Section 2.0

Each committee has a chair and vice-chair. A secretary or recorder may be selected by the chair, if necessary. The committee chair and vice-chair are selected by the Steering Committee.

Section 3.0

The kinds of committees and their members are determined by the Steering Committee. In making their selections, the Steering Committee makes use of expressions of interest filed by the conference participants.

Section 4.0

Each committee shall make an official report of the designated time at each biennial conference. Chair of committees are responsible for submitting the required number of committee reports promptly to the vice-chair of the conference. The conference vice-chair is responsible for assembling and distributing the conference proceedings. Suggested distribution is:

Section 4.1

One copy to each participant on the mailing list.

Section 4.2

One copy to each State Conservationist, NRCS, and Experiment Station Director of the Northeast.

Section 4.3

Five copies to the Director of Soil Survey, NRCS, for distribution to National Office staff.

Section 4.4

Ten copies to the National Soil Survey Center (NSSC) for distribution to staff in the center.

Section 4.5

Two copies to the NRCS Regional Assistant Chief, East and Eastern Region Technical Center

Section 4.6

One copy to each MO 12, 13, and 14 office.

Section 4.7

Two copies to the Eastern and Southern Regions of the National Forest System

Section 4.8

One copy to Agriculture and Ag Food Canada office.

Section 4.9

Much of the work of committees will of necessity be conducted by correspondence between the times of biennial conferences. Committee chairs are charged with the responsibility for initiating and carrying forward this work.

ARTICLE VII - RESPRESENTATIVES TO THE NATIONAL AND REGIONAL SOIL SURVEY CONFERENCES

Section 1.0

The Experiment Station chair or vice-chair will attend the national conference the year prior to the regional conference for which they were selected. A second Experiment Station representative also will attend the conference. The second representative is to be selected by the Experiment Station representatives at the regional conference.

Section 2.0

One NRCS lead soil scientist from the East Region will be designated to attend the National Conference in addition to the NRCS member of the National Conference Steering Team.

Section 3.0

One member of the Steering Committee will represent the Northeast Region at the South, Midwest, and West Regional Soil Survey Conference. If none of the members of the Steering Committee can attend a particular conference, a member of the conference will be selected by the Steering Committee for this duty.

ARTICLE VIII – NORTHEAST SOIL TAXONOMY COMMITTEE

Section 1.0

Membership of the standing committee is as follows:

1. Chair
2. Three federal representatives
3. Three state representatives

Section 2.0

The term of membership is three conferences, with one third replaced each conference. The Experiment Station representatives nominate new Experiment Station representatives to the Steering committee for the following conference. The federal representatives nominate new federal representatives to the steering committee for the following conference.

Section 3.0

The Committee Chair is nominated to the Steering Committee by the Northeast Soil Taxonomy Committee. The Chair for the committee should rotate at the conclusion of each conference. Term of responsibility starts at the end of one conference and finishes with end of next.

ARTICLE IX - NORTHEAST RESEARCH NEEDS COMMITTEE

Section 1.0

This is a standing committee, the purpose of which is to maintain a formal mechanism within the Northeast Region to identify, document, prioritize and address the critical research and development issues related to soil survey.

Section 2.0

Membership of this standing committee is as follows:

2.1 National Leader for Investigations or as assigned by the NRCS Director of the Soil Survey Division. (permanent chair)
2.2 One MO Team Leader (four-year term)
2.3 One NRCS State Soil Scientist (two-year term)
2.4 Two experiment station/university representatives (two-year term)
2.5 One NRCS field soil scientist (two-year term)
2.6 Lead Soil Scientist Eastern Region Technical Center
2.7 U.S. Forest Service Representative (permanent)

Section 3.0

The state soil scientist and field soil scientist will be selected from a different state every two years alternating between each MO. The state soil scientist and field soil scientist will be from different states and different MOs.

Section 4.0

The National Leader for Investigations or as assigned by the NRCS Director of the Soil Survey Division will be responsible for selecting the state soil scientist and NRCS field soil scientist.

Section 5.0

The Experiment Station Conference chair, or vice-chair is responsible for overseeing the selection of the experiment station/university representatives as described in Section 2.4 above.

Section 6.0

The Northern Forest Research Station Research Director will select the appropriate U.S. Forest Service representative.

ARTICLE X – NORTHEAST NEW TECHNOLOGIES STANDING COMMITTEEE

Section 1.0 -- Membership of the standing committee is as follows:

1. Chair
2. Three federal representatives
3. Three state representatives

Section 2.0

The term of membership is three conferences, with one third replaced each conference. The Experiment Station representatives nominate new Experiment Station representatives to the Steering committee for the following conference. The federal representatives nominate new federal representatives to the steering committee for the following conference.

Section 3.0

The Committee Chair is nominated to the Steering Committee by the Northeast New Technology Committee. The Chair for the committee should rotate at the conclusion of each conference. Term of responsibility starts at the end of one conference and finishes with end of next.

ARTICLE XI - SILVER SPADE AWARD

Section 1.0

The award will be presented every two years at the conference meeting. It will be presented to a member of the conference who has contributed outstanding regional and/or national service to soil survey. One or two individuals can be selected for the award every two years. The selection committee will be made up of past award winners with the last award recipient acting as chair of the selection committee. If multiple awards were given at the previous meeting, the chair of the selected committee will be elected by the committee. The recipients of the award will become members of the Silver Spade Club.

ARTICLE XII – AMENDMENTS

Section 1.0

Any part of this statement for purposes, policy and procedures may be amended any time by majority agreement of the conference participants.

By-Laws, Adopted January 16, 1976
By-Laws, Amended June 25, 1982
By-Laws, Amended June 15, 1984
By-Laws, Amended June 20, 1986
By-Laws, Amended June 17, 1988
By-Laws, Amended June 10, 1994
By-Laws, Amended June 13, 1996
By-Laws, Amended June 22, 2000
By-Laws, Amended May 25, 2006

Exhibit 602-4 Bylaws of the North Central Regional Soil Survey Conference
2002 (REVISED)

Article I. Name.

The name of the Conference shall be the North Central Regional Soil Survey Conference. The letters NCRSSC may be used as the official acronym of the conference.

Article II. Purpose.

The purpose of the conference is to bring together North Central States representatives of the National Cooperative Soil Survey (NCSS) for discussion of technical questions. Through the actions of committees and conference discussions, experience is summarized and clarified for the benefit of all; new areas are explored; procedures are proposed; and ideas are exchanged and disseminated. The conference also functions as a clearinghouse for recommendations and proposals received from individual members and state conferences for transmittal to the National Cooperative Soil Survey Conference (NCSSC). It also acts on recommendations from the national conference and other Regional conferences.

Article III. Membership.

Participants of the conference are the National Cooperative Soil Survey soil scientists of Federal, State, University, local units of government and private organizations of the North Central Region (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin). A National Leader of the Natural Resources Conservation Service (NRCS) Soil Survey Division will be a Liaison to the NCRSSC and will maintain a membership list for the Conference and distribute it to the incoming chair. All cooperating agencies and organizations will be responsible to provide update membership information to a Liaison National Leader of Soil Survey Division. All soil scientists or other technical specialists of any cooperating agency or organization whose participation would be helpful for particular objectives or projects of the Conference may be sent including those from the host state.

Article IV. Meetings.

Section 1. *Time.*

The conference will ordinarily convene every 2 years in even-numbered years. The conference chair determines time of year for next meeting. Additional meetings may be called by request of the steering committee or the conference with the administrative approval of the participating agencies and organizations.

Section 2. *Host State.*

The host state is determined two meetings in advance: (e.g., the 2002 conference selects the host state for 2006, the 2004 conference selects the host state for 2008, etc.). During the conference business meeting invitations from the various states are considered and voted upon. A simple majority vote decides the host state. The conference may be held at any suitable location within the host state. The state rotation for the NCRSSC is as follows: Michigan, Wisconsin, Indiana, North Dakota, Kansas, Ohio, Nebraska, Iowa, Minnesota, Illinois, South Dakota, and Missouri.

Section 3. *Separate Meetings.*

University Agricultural Experiment Station representatives to the North Central Regional Committee No. 3 (NCR-3) on soil surveys will meet during the conference. Concurrently, soil scientists of the other cooperating agencies may meet to discuss their issues.

Section 4. *Basic Structure of Regional Conference*

Although the agenda for each conference will vary depending upon current issues and items of interest, the following is a basic recommended list of items that would be included in a North Central Regional Soil Survey Conference. This list can be used as an aid for states planning future conference meetings:

1. Welcome by cooperating host state agencies.
2. Reports by cooperating agencies such as NRCS, NCR-3, Forest Service (FS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), and other agencies and groups as needed.
3. Reports from Major Land Resource Area (MLRA) Regional Offices (MO's) within the North Central Region. These would include: Indianapolis, IN; St. Paul, MN; Salina, KS; Bismarck, ND; Amherst, MA; Morgantown, WV, Little Rock, AR and Lexington, KY.
4. Time allotted for breakout session. These typically are NRCS and NCR-3.
5. Time allotted for committees to meet and discuss charges presented to them by the steering committee as well as time allotted for conference attendees to make input to each committee's activities.
6. Time allotted for committee reports to the conference.
7. Time allotted for a business meeting toward the end of the conference.
8. A half or full day field trip to look at soil related problems or landscapes of some special areas that might be of interest to the group.

Article V. Steering Committee, Officers and Committee Chairs.

Section 1. *The Conference shall have a Steering Committee.*

The steering committee shall consist of:

1. NRCS State Soil Scientist of host state
2. The University representative for host state
3. NRCS and University representative from the next host state
4. Past NCRSSC chair and co-chair
5. Liaison National Leader of Soil Survey Division
6. MO leader for the host site

Officers rotate among agencies. That is, the chair must be of a different agency than the past chair. Similarly, the secretary must be of a different agency than the past secretary. At each biennial conference a secretary is elected for the succeeding conference. The secretary (whoever will be the next NCRSSC chair - either the NRCS State Soil scientist or University Representative) becomes chair when his/her successor is elected. When an officer is unable to complete his/her term of office, the steering committee shall appoint a successor.

Responsibilities of the Steering Committee include the following:

1. The committee will meet once after the business meeting of each conference and may meet at other times if necessary.
2. The steering committee may select individuals that will represent the NCRSSC in conferences of other regions.

3. The steering committee assists in the formulation of charges to committees.
4. The steering committee will be responsible for compiling, editing and distributing the NCRSSC Proceedings to all conference attendees within the 120 days after the conference.
5. Steering committee will forward action items, recommendations and resolutions to appropriate Liaison National Leader of Soil Survey Division and Director of Soil Survey Division.

Section 2. *Conference Officers*

A. Chair.

The chair is from the host state. Responsibilities include the following (specific tasks may be delegated to the secretary):

1. Functions as head of the Steering Committee.
2. Plans and manages the biennial conference.
3. Determines, in consultation with the steering committee, the kinds of committees, selects the committee chairs and assistant chairs, formulate, and transmits charges to committees, and appoints committee members.
4. Issue announcements of and invitations to the conference.
5. Writes the program and has copies prepared and distributed to the membership.
6. Makes necessary arrangements for: food and lodging accommodations; special food functions; meeting rooms (including committee rooms); and local transport for official functions.
7. Provides for appropriate publicity for the conference.
8. Presides at the business meeting of the conference.
9. Make arrangements for a half or full day field trip.

B. Secretary.

The secretary is from the state that will host the next biennial conference. The secretary for the succeeding conference (in 2 years) is elected by simple majority vote at NCRSSC business meeting.

Responsibilities of the Secretary include the following:

1. Assists in the planning and management of the conference.
2. Assists in the selection of committee chairs and assistant chairs and in the selection of committee members.
3. Responsible for taking of all business meeting minutes, collecting final reports from committees, and collecting any papers or presentations given during the conference.
4. Responsible for forwarding all conference minutes, reports and papers to the Liaison National Leader of Soil Survey Division for the final preparation and distribution of the NCRSSC Proceedings.
5. Updates the conference membership list (given to him/her by the Chair upon conclusion of each conference) and provides the list to the Liaison National Leader of Soil Survey Division.

Section 3. *Committee Chairs.*

The conference chair in consultation with the steering committee selects the chair and co-chair for each committee.

Article VI. Committees.

Section 1. The constituted committees accomplish most of the technical work of the conference. The committees of the Conference shall be determined by the Steering Committee. Some committees will continue from the previous conference. Permanent or standing committees, ad hoc committees, and task force groups are considered to be committees of the Conference.

Section 2. The Committee Chair will select a secretary, or recorder. Committee members shall be selected after considering Steering Committee recommendations, National Conference recommendations, individual interests, technical proficiency, and continuity of the work. They are not limited to members of the National Cooperative Soil Survey.

Section 3. Each committee commonly conducts its work by correspondence among committee members. Most of the committee's communications will be by correspondence. Copies of all correspondence between members of the steering committee shall be sent to each member of the committee.
Committee chairs shall provide their committee members with the charges as assigned by the Steering Committee and procedure for committee operation. Committee chairs are charged with responsibility for initiating and carrying forward this work. Chairs should initiate committee work at the earliest possible date. Each committee shall meet during the conference to permit other conference attendees to make input to each committee's activities.

Section 4. Each committee chair shall send copies of a final committee report to the Secretary within the 30 days after the Conference.

Section 5. A standing committee will address proposed changes in soil taxonomy. Three members to be determined by NCR-3 and three members to be appointed the conference chair.

Article VII. Representation.

Delegates to the National Cooperative Soil Survey Conference will include the Liaison National Leader of Soil Survey Division, and a NCR-3 (state) delegate from the current host state for NCRSSC. These two delegates will also serve on the steering committee for the NCSSC. Two additional delegates to the NCSSC will include one NCRS soil scientist and one NCR-3 (state) representative (with appropriate administrative approval). The NCRS soil scientist will be chosen by simple majority vote during the separate federal session. The second NCR-3 delegate will come from the next NCRSSC host state and be assigned the task of presenting the NCRSSC report at the NCSSC. Both NCR-3 delegates will be chosen by simple majority vote during the separate NCR-3 session at the NCRSSC.

Article VIII. Historical Record.

A cumulative file of conference programs shall be turned over to each incoming conference chairman. A cumulative file should be keep at office of a Liaison National Leader of Soil Survey Division.

Article IX. Amendments.

The by-laws may be amended at any time by a simple majority vote of the participants attending the biennial business meeting. An amendment shall, unless otherwise provided therein, be effective immediately upon adoption and shall remain in effect until changed.

Exhibit 602-5 Bylaws of the Southern Regional Cooperative Soil Survey Conference

Article I Name

Section 1 The name of the Conference shall be the Southern Regional Cooperative Soil Survey Conference.

Article II Geographic Boundary

Section 1 The Southern Region corresponds to the Agricultural Experiment Station Southern Region and includes the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and the Caribbean Area.

Article III Purpose

Section 1 The purpose of the Southern Regional Cooperative Soil Survey Conference is to bring together representatives of the National Cooperative Soil Survey in the southern states for discussion of technical, scientific, and other general questions and issues of importance to the Cooperative Soil Survey Program. Through the actions of committees and conference discussions, experience is summarized and clarified for the benefit of all; new areas are explored; procedures are synthesized; and ideas are exchanged and disseminated. The conference also functions as a clearinghouse for recommendations and proposals received from individual members and state conferences for transmittal to the National Cooperative Soil Survey Conference.

Article IV Participants

Section 1 Permanent participants of the conference are the following:

- *Section 1.1* The NRCS State Soil Scientist, Staff Soil Scientists, and the MLRA Office Soil Scientists responsible for each of the states and U.S. Territories assigned to the South Region.
- *Section 1.2* The Experiment Station or University's National Cooperative Soil Survey Leader(s) of each of the states and U.S. Territories assigned to the South Region.
- *Section 1.3* Representatives from the 1890 Land Grant Universities and Tuskegee University.
- *Section 1.4* Soil Scientists assigned to the NRCS Southeast and South Central Regional Offices.
- *Section 1.5* National Soil Survey Center Liaisons assigned to the MLRA Offices within the South Region.
- *Section 1.6* Representative from the National Cartography and Geospatial Center.
- *Section 1.7* Representative from the Information Technology Center at Ft. Collins, Colorado.
- *Section 1.8* Representatives from the regional soils staff of the USDA Forest Service.
- *Section 1.9* Soils discipline representative from the Tennessee Valley Authority.
- *Section 1.10* Representative from the National Society of Consulting Soil Scientists, Inc.

Section 2 On the recommendation of the Steering Committee, the Chair of the conference may extend invitations to other individuals to participate in committee work and in the conference. Any soil scientist or other technical specialists of any state or federal agency or private consultant whose participation is helpful for particular objectives or projects of the conference may be invited to attend.

Article V Organization and Management

Section 1 Steering Committee

A Steering Committee assists in the planning and management of the biennial conference, including the formulation of committee memberships, selection of the committee chair and vice-chair, and organizing the program of the conference.

Section 1.1 Steering Committee Membership

The Steering Committee consists of five members:

a. The conference chair.

b. The conference vice-chair.

c. Soil Scientist assigned to either the Southeast or South Central Regional Office of NRCS.

d. One MLRA Team Leader.

e. The past conference chair.

Appendix III contains a schedule that can be used to determine the appropriate rotations of assignments.

The Steering Committee is chaired by the Soil Scientist serving under item 3 above.

The Steering Committee may designate a conference chair and vice chair if the persons designated in Section 2.0 are unable to fulfill their obligations.

Section 1.2 Meetings and Communications

A planning meeting will be held about 1 year prior to the conference. The chair may schedule additional meetings if the need arises. Most of the steering committee's communications will be in writing. Copies of all correspondence between members of the committee shall be sent to all members of the steering committee.

Section 1.3 Authority and Responsibilities

Section 1.3.1 Conference participants

The Steering Committee formulates policy on conference participants, but final approval or disapproval of changes in policy is by consensus of the participants. The Steering Committee makes recommendations to the conference for extra and special participants in specific conferences.

Section 1.3.2 Conference Committees

The Steering Committee formulates the conference committee membership and selects the committee chair and vice-chair. The Steering Committee is responsible for the formulation of committee charges.

Section 1.3.3 Conference Policies

The Steering Committee is responsible for the formulation of statements of conference policy. Final approval of such statements is by consensus of the conference participants.

Section 1.3.4 Liaison

The Steering Committee is responsible for maintaining liaison between the regional conference and:

1. The Experiment Station Directors within the Southern Region.
2. The State Conservationists, NRCS, for the states within the Southern Region.
3. The Regional Conservationists for the Southeast and South Central NRCS regions.
4. Director, Soils Division, NRCS.
5. Regional and national offices of the U.S. Forest Service.
6. The National Cooperative Soil Survey Conference.
7. Southern Forest Soils Research Council.
8. Other cooperating and participating agencies and private individuals.

Section 1.4 Responsibilities of the Steering Committee Chair are:

Section 1.4.1 Call a planning meeting of the Steering Committee about 1 year in advance of the conference to plan the agenda, and if possible, at the scheduled location of the conference.

Section 1.4.2 Develop with the Steering Committee the conference's committees and their charges.

Section 1.4.3 Send committee assignments to committee members. The committee assignments will be determined by the Steering Committee at the planning meeting. The proposed chair and vice chair of each committee will be contacted personally by a member of the conference steering committee and asked if they will serve prior to final assignments.

Section 1.4.4 Compile and maintain a conference mailing list (can be copies on mailing labels).

Section 2 Conference Chair and Vice-Chair

The conference chair and vice-chair are the State Soil Scientist and Experiment Station Soil Survey Leader from the state where the next conference is to be held. These officers serve a two-year term from close of conference to close of conference. The chair position, for each two-year period, alternates between the state soil scientist and experiment station representative. This sequence may be altered by the Steering Committee for special situations.

Section 2.1 Responsibilities of the conference chair:

Section 2.1.1 Functions as chair of the biennial conference.

Section 2.1.2 Planning and management of the biennial conference.

Section 2.1.3 Serve as a member of the Steering Committee.

Section 2.1.4 Send out a first announcement of the conference about 9 months prior to the conference.

Section 2.1.5 Send out written invitations to all speakers or panel members and representatives from other regions. These people will be contacted beforehand by phone or in person by various members of the steering committee.

Section 2.1.6 Send out written requests to Experiment Station representatives to find out if they will be presenting a report at the conference.

Section 2.1.7 Notify all speakers, panel members, and Experiment Station representatives in writing that a brief written summary of their presentation will be requested after the conference is over. This material will be included in the conference's proceedings.

Section 2.1.8 Preside over the conference.

Section 2.1.9 Provide for appropriate publicity for the conference.

Section 2.1.10 Preside at the business meeting of the conference.

Section 2.1.11 Appoint a recording secretary to take minutes of the business meeting and prepare minutes for inclusion in the proceedings of the conference.

Section 2.2 Responsibilities of conference vice-chair:

Section 2.2.1 Serve as Program Chair of the biennial conference.

Section 2.2.2 Serve as a member of the Steering Committee.

Section 2.2.3 Act for the chair in the chair's absence or disability.

Section 2.2.4 Develop the program agenda of the conference. Time is to be provided on the conference agenda for separate state and federal meetings.

Section 2.2.5 Make the necessary arrangements for lodging accommodations for conference members, for food or social functions, for meeting rooms, including committee rooms, and for local transport for official functions. Notify all persons attending the conference of the arrangement for the conference (rooms, etc.). Included in the last mailing will be a copy of the agenda.

Section 2.2.6 Compile and distribute the proceedings of the conference. If these bylaws are amended, the proceedings shall contain a copy of the new by-laws.

Section 3 Past Conference Chair The primary responsibility of the past conference chair is to provide continuity from conference to conference. Additional responsibilities include the following:

Section 3.1 Serve as a member of the Steering committee.

Section 3.2 Assist in planning the conference.

Section 4 Administrative Advisors
Administrative advisors to the conference consist of a NRCS State Conservationist (usually, but not necessarily, from the state where the conference is held) and an Experiment Station Director (usually, but not necessarily from the state where the conference is held). In addition, other advisors may be selected by the steering committee or the conference.

Article VI Time and Place of Conference

Section 1 The conference convenes every two years, in even-numbered years. During the biennial business meeting, invitations from the various states are considered, discussed and voted upon. A simple majority vote decides the location of the next conference. Appendix I can be used as a guide for determining meeting locations. The date and specific location will be determined by the Steering Committee.

Article VII Conference Committees

Section 1 Most of the work of the conference is accomplished by duly constituted committees.

Section 2 Each committee has a chair and vice-chair. A secretary or recorder may be selected by the chair, if necessary. The committee chair and vice-chair are selected by the Steering Committee.

Section 3 The kinds of committees and their members are determined by the

Steering Committee. In making their selections, the Steering Committee makes use of expressions of interest filed by the conference participants.

Section 4 Much of the work of committees will of necessity be conducted by correspondence between the times of biennial conferences. Committee chairs are charged with the responsibility for initiating and carrying forward this work.

Section 5 Each committee shall make an official report at the designated time at each biennial conference. Chair of committees is responsible for submitting the required number of committee reports promptly to the vice-chair of the conference.

Section 5.1 Suggested distribution is:

Section 5.1.1 One copy to each participant on the mailing list.

Section 5.1.2 One copy to each State Conservationist, NRCS, and Experiment Station Director in the Southern Region

Section 5.1.3 Five copies to the Director of Soils, NRCS, for distribution to National Office staff.

Section 5.1.4 Ten copies to the National Soil Survey Center (NSSC) for distribution to staff in the Center.

Section 5.1.5 Three copies to the Soil Scientists representing the Southeast and South Central NRCS regions for distribution and circulation to both the NRCS and cooperators within their regions.

Section 5.1.6 Five copies to the Forest Service Regional Soil Scientist.

Article VIII Representatives to the National and Regional soil Survey Conferences

Section 1 At least one state and one federal member will represent this conference at the National Cooperative Soil Survey Conference. Selections are to be made by the appropriate administrators. Representatives will report back to their respective state or federal group.

Section 2 One member of the Steering Committee will represent the Southern Region at the Northeast, North Central and West Regional Soil Survey Conference. If none of the members of the Steering Committee can attend a particular conference, a member of the conference will be selected by the Steering Committee for this duty.

Article IX Southern Region Soil Taxonomy Committee

Section 1 Membership of the standing committee is as follows: Lead Scientist, Soil Taxonomy (permanent chair). MLRA Team Leaders representing MLRA Regions 9, 13, 14, 15, and 16 (permanent members). Three experiment station representatives (rotating members).

Section 2 At their respective business meetings, the experiment station representatives will be elected to serve on this committee. The term of membership is three years, with two members elected at each biennial conference. One member's term will begin immediately and the other will begin one year later.

Article X Southern Regional Technical Committee for Hydric Soils

Section 1 Membership of the standing committee is as follows:
Three university members

Three USDA Natural Resources Conservation Service (NRCS) members
One U.S. Environmental Protection Agency (EPA) member
One U.S. Army Corps of Engineers (CORPS) member
One U.S. Fish and Wildlife Service (FWS) Member
One USDA Forest Service (FS) members
One member of the National Society of Consulting Soil Scientists, Inc. (NSCSS).

Section 2 At their respective business meetings during the biannual conference, the university and NRCS representatives will be elected to serve on this committee. The term of membership is three years, with two members elected at each biannual conference. One newly elected member's term will begin immediately and the other will begin one year later. The method for placing members on the committee used by the other agencies will be determined by those agencies' regional or national leadership.

Article XI Amendments

Section 1 Any part of this statement of By-Laws may be amended any time by majority agreement of the conference participants.

By-Laws Adopted June 9, 1990
By-Laws Amended July 11, 1968
By-Laws Amended May 7, 1970
By-Laws Amended May 25, 1984
By-Laws Amended June 22, 1990
By-Laws Amended April 19, 1996
By-Laws Amended June 26, 1998

Appendix I: Southern Regional Technical Committee for Hydric Soils

Affiliation	1998	1999	2000	2001	2002
University	David Pettry	David Pettry	David Pettry	David Pettry	
University	Mike Vepraskas	Mike Vepraskas	Mike Vepraskas		
University	Wayne Hudnall	Wayne Hudnall			
NRCS	Jerry Daigle	Jerry Daigle	Jerry Daigle	Jerry Daigle	
NRCS	John Gagnon	John Gagnon	John Gagnon		
NRCS	Ben Stuckey	Ben Stuckey	Wes Miller	Wes Miller	Wes Miller
EPA					
CORPS					
FWS					
FS					
NSCSS					

Appendix II

Recommendations for Future Conference Locations; Conference Chair and Vice Chair; Steering Committee Chair; and MLRA Office Representative to Steering Committee.

YEAR HOST STATE CONFERENCE CHAIR CONFERENCE VICE CHAIR STEERING CHAIR STEERING MLRA REP.
1998 LA SSS - LA EXP STA - LA SOUTH CENTRAL RALEIGH
2000 AL EXP STA - AL SSS - AL SOUTHEAST TEMPLE
2002 MS SSS - MS EXP STA - MS SOUTH CENTRAL MORGANTOWN
2004 GA EXP STA - GA SSS - GA SOUTHEAST LITTLE ROCK
2006 OK SSS - OK EXP STA - OK SOUTH CENTRAL AUBURN
2008 FL EXP STA - FL SSS - FL SOUTHEAST TEMPLE
2010 TX SSS - TX EXP STA - TX SOUTH CENTRAL RALEIGH
2012 KY EXP STA - KY SSS - KY SOUTHEAST LITTLE ROCK
2014 TN SSS - TN EXP STA - TN SOUTH CENTRAL AUBURN
2016 PR EXP STA - PR SSS - PR SOUTHEAST TEMPLE
2018 NC SSS - NC EXP STA - NC SOUTH CENTRAL MORGANTOWN

2020 AR EXP STA - AR SSS - AR SOUTHEAST LITTLE ROCK
2022 SC SSS - SC EXP STA - SC SOUTH CENTRAL RALEIGH
2024 LA EXP STA - LA SSS - LA SOUTHEAST TEMPLE

In addition to the above, the past conference chair also serves on the steering committee.

Part 606 - WORKING AGREEMENTS

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Part 606 - WORKING AGREEMENTS

606.00 Definition.

Working agreements are a basis of understanding for cooperative work with other agencies and organizations. These agreements include memoranda of understanding (MOU), contribution agreements, interagency agreements, and trust fund agreements. The Natural Resources Conservation Service (NRCS) or any public agency may initiate working agreements relating to soil survey activities. If another Federal agency initiates a working agreement, the name of the document and the format may be different from those used by the NRCS. Cooperators operate within their own sphere of authority. Guidelines are in subpart 104I-73.101 of the NRCS Property Management Regulations. A memorandum of understanding is not a contract, nor are the plans and specifications agreed upon and contained therein legally binding for the agencies that sign it. The MOU may provide for other working agreements such as contribution agreements, interagency agreements, or trust fund agreements for transfer of funds, services, space, or equipment.

606.01 Policy and Responsibilities.

Memoranda of understanding record the intent of the NRCS and one or more cooperators to join together in updating soil survey information, making a soil survey of a specific area, or in performing related soil survey work. The NCSS requires that each MLRA Regional Office (MO) has a memorandum of understanding covering all of the land in the region (referred to as an MLRA Region-wide MOU). Other MOUs can be developed (but are not required) as deemed necessary for areas beginning an initial soil survey or for areas undergoing normal updating activities. Examples include: (1) a project soil survey of an individual area such as county or parish (often referred to as an "initial soil survey"), (2) an entire state (through a statewide memorandum of understanding), and (3) an MLRA Soil Survey Project Area. Any standards, specifications, or other guidance included in optional MOUs must be compatible with the MLRA Region-wide MOU.

Part 104I-73 of the Property Management Regulations (issued 1984) gives specific instructions and authority concerning working agreements such as memoranda of understanding, contribution agreements, and interagency agreements. Other guidance is found in the NRCS Grants and Cooperative Agreements Handbook, and Contribution Agreements Handbook.

When NRCS is to receive outside funds, services, or office space, the state conservationist ensures the preparation of a contribution agreement, interagency agreement, or trust fund agreement in addition to a memorandum of understanding.

(a) Memoranda of Understanding.

(1) MLRA Region-wide Memorandum of Understanding.

(i) Each of the NRCS MLRA Regional Offices (MOs) must have a region-wide memorandum of understanding that covers all the land within the MLRA region. The memorandum of understanding includes information about the region, the purpose for doing the work, responsibilities of cooperators, and other information that would require signatures of cooperators. New cooperators that did not sign the original MOU can be added by signing at any time.

(ii) The MLRA Regional Office leader prepares the MLRA region-wide memorandum of understanding for approval by the state conservationists, state agricultural experiment station leaders, and other cooperating agencies as appropriate. The MLRA region-wide memorandum of understanding is an umbrella document necessary to help ensure that maintenance of soil information, soil mapping, and soil interpretation are conducted according to common technical standards within physiographic regions.

(iii) The Outline for a Memorandum of Understanding for a MLRA Region.

- Heading. Identify the document as a memorandum of understanding between the Natural Resources Conservation Service and the other cooperating organizations that will be signatories, relative to the making and modernization of all soil surveys within the region.
- Authority. State the authority for doing the work. It is usually Public Law 74-46, 49 Stat. 163 (16 U.S.C. 590 a-f) and Public Law 89-560. 80 Stat. 706 (42 U.S.C. 3271-3274).
- Purpose. Describe the purpose for establishing the MOU. This will generally include general information about the National Cooperative Soil Survey partnership and it's mission, and the need to complete remaining initial soil survey projects and to improve and coordinate existing soil surveys.
- Description of the area. Provide general information about the region such as its physiography, cropping and land use patterns, and land ownership.
- Responsibilities. For each of the agencies signing the MOU, list their responsibilities relative to soil survey in the region.
- Specifications. Describe the expected products to be produced. Reference the adherence to relevant NCSS standards for describing, classifying, and mapping soils. This section should be general enough to allow for flexibility within the region as appropriate for order of soil surveys, design of map units, kinds of interpretations to be provided , etc., but detailed enough to ensure that NCSS standards will be adhered to for all soil survey activities.
- Provide the current non-discrimination statement.
- Signatures.

(iv) Exhibit 606-1 is an example of an MLRA Region-wide Memorandum of Understanding.

(2) Project Soil Survey Area Memorandum of Understanding (optional). A project soil survey (initial soil survey or update soil survey requiring extensive revision) is a progressive survey that is governed by project management procedures which ensure that all activities (including field work, correlation, digital map preparation, digital map finishing, and the final manuscript draft, for the survey) is completed in 5 years or less from the date of the initial quality assurance review.

(i) The State Soil Scientist prepares the MOU for a project soil survey area. The Memorandum of Understanding records the purpose of the survey, describes the area, lists cooperators and their responsibilities, and records the specifications for making, documenting, interpreting, and publishing a soil survey for a specific area. The details included within this MOU must be compatible with the MLRA Region-wide MOU.

(ii) All soil survey projects are to be managed in the context of a major land resource area. This approach maintains a consistent scale and level of detail among all of the surveys within the major land resource area and enables exact joins among the surveys. All project soil surveys are conceptual subsets of the larger Major Land Resource Area Soil Survey Area of which they are a part. The goal is to produce a geographically coordinated soils legend, map, and database irrespective of political boundaries. This assures consistent soil information for each soil across the region, and also facilitates equitable soil-related applications in conservation programs across political boundaries.

(iii) The Outline for a Memorandum of Understanding for a Project Soil Survey Area.

- Heading. Identify the document as a memorandum of understanding between the Natural Resources Conservation Service and the other cooperating organizations that will be signatories, relative to the making a soil surveys. Coordinate the name and unique identification code with the National Soil Survey Center (Hotline staff).
- Authority. State the authority for doing the work. It is usually Public Law 74-46, 49 Stat. 163 (16 U.S.C. 590 a-f) and Public Law 89-560. 80 Stat. 706 (42 U.S.C. 3271-3274).
- Purpose. Determine the purpose, needs, and objectives of a soil survey in consultation with local users and cooperators. Identify the principal potential users. Give specific purposes and uses of the survey, such as for intensive land development, irrigated cropland, commercial timber production, assessment of agricultural land, community development, or multipurpose public recreation. Cite the MLRA region-wide memorandum of understanding, and ensure that objectives of the project soil survey area meet the objectives outlined in the region-wide memorandum.
- Description. Give a brief description of the work area, describing location, size, and physiographic composition. If more than one intensity of field operations is planned for the same soil survey area and the extent is significant, show the approximate acreage of each field operation. List the acreage of Federal lands, if significant, that each agency administers. Such agencies are Forest Service, National Park Service, Bureau of Land Management, and Department of Defense, and such lands as Indian Tribal Lands.
- Responsibilities. Identify the agencies and their responsibility for the work. Describe the specific kind and amount of work to be done by each cooperating agency that signs the memorandum of understanding. Include field work, laboratory analyses, and special studies. Reference the MLRA region-wide MOU and, if applicable, the state-wide MOU.
- Specifications. List the specifications necessary for conducting the work. For example:
    - Specify the minimum standard or documentation to be used for quality control.
    - Indicate whether or not small areas of contrasting soils or miscellaneous areas will be shown on the maps using point and/or line features.
    - Give general guidance on how the field work will be conducted.
    - Give base imagery data, including the supplying agency, kind, and format, such as full quad or quarter quad orthophoto, and scale to be used in making the soil survey.
    - Identify supplemental imagery available to assist in field operations and the supplying agency.
    - Specify latitude and longitude with stated datum for locating information collected.
    - Identify major soil interpretations for inclusion in the published survey.
- Key Dates. List the key dates selected to organize, manage, and complete the work, and analyze the workload as necessary.
- List briefly the plans for publication.
- Provide the current non-discrimination statement.
- Signatures.

(3) State-Wide Memorandum of Understanding (optional). Individual states may have a memorandum of understanding with cooperating agencies that pertains to soil surveys in general in the state. These statewide memoranda of understanding are prepared by the State Soil Scientist to recognize the joint and individual responsibilities of cooperators for the development and utilization of soil surveys in the state. The details included within this MOU must be compatible with the MLRA Region-wide MOU. A statewide MOU usually includes:

(i) a title block,
(ii) definitions of terms used,
(iii) the general purpose of the memorandum,
(iv) items of mutual agreement,
(v) items of individual agency agreement, and
(vi) signature blocks and dates.

(4) Other Memoranda of Understanding.

A MOU may be developed at the discretion of the State Conservationist for any other geographic area if it is beneficial to the parties involved. It must be compatible with the MLRA Region-wide MOU.

(5) Review, Approval, and Distribution of Memorandum of Understanding.

State conservationists of NRCS are responsible for maintaining the adequacy of official soil survey information for state and private lands. They coordinate NRCS activities with others that have responsibility for the adequacy of soil survey information on federally administered lands.

(i) Review. An interdisciplinary, interagency team as appropriate, including administrative support staff reviews the draft (or substantially revised) memorandum of understanding. The state conservationist sends a copy for review and comment to:

- each cooperating signer,
- other affected state conservationists,
- National Soil Survey Center (for MLRA Region-wide MOUs only),
- MLRA Regional Office,
- MLRA Soil Survey Office,
- Soil Survey Project Office (for project soil survey area MOUs),
- affected state soil scientists, and
- others, as appropriate, such as principal user groups.

Reviewers return the draft copy of the memorandum of understanding to the originating state for resolution of the review comments.

(ii) Approval. Upon resolution of all reviewer comments, the state conservationist and the appropriate officials of cooperating agencies approve the memorandum of understanding by signing the document.

(iii) Distribution. The state conservationist distributes the original signed memorandum of understanding to the state office administrative services file and copies to:

- the MLRA Regional Office,
- the MLRA Soil Survey Office,
- the Soil Survey Project Office (for project soil survey area MOUs),
- each cooperating agency representative who signed the MOU,
- the Director, National Soil Survey Center,

- the Director, Soil Survey Division,
- the National Cartography and Geospatial Center,
- the National Geospatial Development Center,
- Area Conservationist or Assistant State Conservationist for Field Operations (for project soil survey area MOUs),
- District Conservationist (for project soil survey area MOUs), and
- other involved states.

(6) Amending an Existing Memorandum of Understanding.

(i) Prepare an amendment to the memorandum of understanding if a significant change is made in the work or work area. If the boundaries or other specifications change, issue an amendment to a current memorandum.

(ii) Rewrite only the section(s) for which a significant change is being made. Examples of significant changes for project soil surveys are:

- the area to be mapped is changed,
- the purpose for doing the survey is changed in full or in part,
- specific plans for publishing the survey are changed, or
- specifications for map scale or format or for text format are changed.

(iii) Amendments follow the same review and distribution procedures as outlined for the original memorandum of understanding.

(iv) An amendment is not needed if additional cooperators want to sign the original memorandum of understanding after it has been completed. The additional signature page(s) should be forwarded to all the cooperators identified in the document in addition to a new cover page and a statement of the new cooperator's responsibilities. The former signers do not need to sign the document again.

(b) Description of a Contribution Agreement.

Initiate a contribution agreement if funds, services, or office space from outside nonfederal sources are to be received by the NRCS during or after the soil survey work. Refer to subpart 104I-73.103 of the NRCS Property Management Regulations and to 104I-73.300 for a sample of a soil survey contribution agreement. Send a signed copy to the parties of the agreement and to the Director, Soil Survey Division. If the NRCS enters a reimbursable agreement with another federal agency and NRCS receives reimbursement for doing soil surveys for that agency, ensure that all costs are covered, including overhead. A current memorandum of understanding must be in effect prior to the development of a contribution agreement.

(c) Description of a Trust Fund Agreement.

Initiate a trust fund agreement if funds from outside sources are to be received by the NRCS in advance of the soil survey work (refer to subpart 104I-73.200 of the NRCS Property Management Regulations). Send a copy of the signed agreement to the parties of the agreement and to the Director, Soil Survey Division.

(d) Description of an Interagency Agreement.

Interagency Agreements or "Joint Agreements" with federal agencies -- federal agencies use their own authorities, however there are times when federal agencies co-mingle funds with one agency taking the lead to carry out a mutual undertaking. The program funding authority for each of the agencies must provide specific authority to carry out the undertaking; otherwise they cannot co-mingle funds. The agencies may have to enter into a joint agreement using separate program authorities with no lead agency.

(e) Other Documents Required for Planning and Managing Soil Survey Projects.

(1) MLRA Soil Survey Offices are required to have:

(i) a work load analysis – long-range plan describing what is needed throughout the assigned area to bring all previous work up to a common, modern standard. The highest priority needs are identified and used to develop a project plan of operations.

(ii) a project plan of operations describing the priority work to be accomplished over about a 2 to 5 year period, and

(iii) an annual plan of operations.

(2) Soil Survey Project Offices (those conducting initial soil surveys, or update soil surveys requiring extensive revision) must have:

(i) a long-range plan detailing all activities needed to complete the work within about a 5-year period, and

(ii) an annual plan of operations.

(3) See Parts 608 and 610 for additional information about these documents.

Exhibit 606-1 MLRA Region-wide Memorandum of Understanding.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATIONAL COOPERATIVE SOIL SURVEY

MEMORANDUM OF UNDERSTANDING

between the

NATURAL RESOURCES CONSERVATION SERVICE
and the
FOREST SERVICE
and the
U. S. DEPARTMENT OF INTERIOR
BUREAU OF INDIAN AFFAIRS
and the
BUREAU OF LAND MANAGEMENT
and the
NATIONAL PARK SERVICE

in IDAHO, MONTANA, OREGON, WASHINGTON, AND WYOMING

and the
COLLEGE OF AGRICULTURE
UNIVERSITY OF IDAHO
and the
IDAHO SOIL CONSERVATION COMMISSION
and the
MONTANA AGRICULTURAL EXPERIMENT STATION
MONTANA STATE UNIVERSITY
and the
OREGON AGRICULTURAL EXPERIMENT STATION
OREGON STATE UNIVERSITY
and the
WASHINGTON AGRICULTURAL RESEARCH CENTER
WASHINGTON STATE UNIVERSITY
and the
WYOMING AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF WYOMING

RELATIVE TO THE MAKING AND MODERNIZATION OF ALL SOIL SURVEYS WITHIN MAJOR LAND RESOURCE AREA SOIL SURVEY REGION 4 - NORTHERN ROCKY MOUNTAIN REGION

AUTHORITY: Public Law 74-46, 49 Stat. 163 (16 U.S.C. 590 a-f) and Public Law 89-560, 80 Stat. 706 (42 U.S.C. 3271-3274).

PURPOSE: The Natural Resources Conservation Service (NRCS) and the National Cooperative Soil Survey (NCSS) partnership have a common objective of providing service to soil survey program participants in an effective and efficient manner.

The purpose of this memorandum of understanding (MOU) is to encourage cooperation and to outline how the NCSS partnership will work together within MLRA Soil Survey Region 4 to bring soil surveys to a common maintenance level. Effective cooperation among participants will improve their respective abilities to provide service to the soil survey program as well as significantly advance the individual partnership mission.

This memorandum of understanding serves as a blanket memorandum of understanding for Major Land Resource Area Soil Survey Region 4. It provides the guidance needed for the Northern Rocky Mountain Region 4 MLRA Regional Office to be able to conduct business, such as the completion of an initial soil inventory and continued modernization efforts of the 82 soil surveys within the business area. Work will be done in accordance with National Cooperative Soil Survey (NCSS) standards at a scale of 1:24,000 or 1:12,000. The intent of this memorandum of understanding is to ensure that the soil survey work in the area provides scientifically sound, up-to-date, coordinated soil survey information. The mission of the cooperative soil survey is to assist humankind in understanding and wisely using soil resources to achieve and sustain a desirable quality of life. This mission is achieved by maintaining a strong scientific basis for defining and describing soil landscape relationships important to the use and management of soils; by providing scientific expertise to identify, classify, characterize, correlate, and interpret soils; by making field investigations, remote sensing and laboratory information and its interpretation readily available through texts, maps, digital products, and other databases; and by assisting people in the use of soil survey information.

There is a need to complete the initial soil inventory. There is also a need to maintain soil survey information that builds on existing soil surveys and develop a coordinated database that addresses local, regional, and national concerns. These projects will enable decision makers to make more informed environmental assessments and resource management decisions. They will also provide more comprehensive soil and site data for (1) managing public and private land, (2) protecting water quality and conserving water quantity, (3) improving and maintaining cropland, rangeland, and forestland, (4) developing wildlife habitat, (5) preparing watershed and urban plans, and (6) providing community and rural development soil interpretations and potentials.

This memorandum of understanding will help to ensure that soil mapping and interpretation are conducted according to common standards within the Northern Rocky Mountain Region. Consequently it serves as the guidance document for developing individual soil survey work load analysis and project plans of operations within the Region. Project plans of operations contain the technical standards, specifications, publication plans, staffing plans, and schedules for completing the remaining initial soil surveys in the region, as well as specific priority activities that have been identified for MLRA soil survey office staffs. They also include any specific responsibilities of cooperators as related to these projects. Any trust fund agreements or reimbursements between agencies or local units of governments for projects would also be covered by separate contribution, interagency, or trust fund agreements.

This memorandum of understanding supersedes all previous MLRA region-wide memoranda of understanding within this region upon the signature of the last person signing the document.

DESCRIPTION OF THE WORK AREA: The Northern Rocky Mountain Major Land Resource Area Soil Survey Region 4 consists of seven MLRAs. These areas cover parts of Idaho, Montana, Oregon, Washington, and Wyoming. The area consists of approximately 86,274,451 acres. Approximately sixty percent of these acres are federal land.

MLRAs in Soil Survey Region 4 are: Northern Intermountain Desertic Basins (32), Semiarid Rocky Mountains (33), Northern Rocky Mountains (43A), Central Rocky Mountains (43B), Blue Mountains-Seven Devils (43C), Northern Rocky Mountain Valleys (44), and Northern Rocky Mountain Foothills (46). The region varies from rugged mountains to broad valleys to semi desert plateaus and basins. Grazing is the leading land use throughout the region but logging is important in some of the forested mountain areas. Irrigation is practiced in some of the valleys and dryland farming in others. Grain and forage for livestock are the main crops. Beans, peas, sugar beets, and seed crops are also grown in places where soils, climate, and markets are favorable.

LAND AREA
ACREAGE TOTALS*

There are about 86,274,451 acres in the region
About 24,796,509 in Idaho
About 36,676,300 in Montana
About 2,178,304 in Oregon
About 2,459,190 in Washington
About 20,164,148 in Wyoming

The US Forest Service Manages about 45,995,992 acres or about 53% of the area
Native American Land is about 3,940,361 acres or about 5%of the area
Other nonfederal land is about25,286,871 acres or about 29% of the area
Bureau of Land Management manages about 6,239,587 acres or about 7% of the area
National Park Service manages about 3,311,906 acres or about 4 % of the area
Other Federal Land about 674,881 or less than 1% of the area
Census water is about 824,853 or about 1% of the area
* Acreage adjusted to coincide with MLRA Soil Survey Region 4 boundary. Acreage values are close approximations.

RESPONSIBILITIES: Technical responsibilities are identified in this section. Administrative responsibilities for acquisition of monies, personnel, equipment, office space, and other in-kind services are also indicated. However, they are contingent upon separate cooperative agreements and trust fund agreements developed by states or units of government.

Lead agencies responsible for project soil surveys will prepare memoranda of understanding (work plans); develop sampling plans and conduct soil investigations; provide the controlled base imagery and supporting cartographic materials for field mapping and publication; prepare the soil survey manuscript(s); and complete the map compilation, digitizing, and map finishing for those surveys.

A. The USDA Natural Resources Conservation Service (NRCS) will:

1. Characterize the soils by laboratory analyses where appropriate.
2. Where NRCS is the lead agency, conduct quality assurance reviews, prepare trip reports, quality assurance reports, correlation documents, and provide field technical assistance for soil surveys in the region.
3. Cooperate with other agencies in providing public relations regarding progress of surveys, uses of soil survey information, and distribution of soil survey data.

4. Provide technical leadership for soil survey attribute (NASIS) and spatial (SSURGO) data development and provide access to that information for the development of agency products.
5. Coordinate all soil survey activities across the soil survey region and between other regions for exact joins.

B. The USDA Forest Service (FS) will:

1. Participate in quality assurance reviews, field studies, and soil correlation for project soil surveys containing FS lands.
2. Cooperate in the conduct of the National Cooperative Soil Survey by allowing access to intermingled lands and by conducting soil surveys on the lands under the jurisdiction of the Forest Service.
3. Share available soil moisture and temperature, forestland and rangeland data.
4. Cooperate in ensuring exact joins between soil survey areas.
5. Provide guidance and assistance in other phases of the soil survey program.

C. The USDI Bureau of Indian Affairs (BIA) will:

1. Participate in quality assurance reviews, field studies, and soil correlation for project soil surveys containing Native American lands.
2. Cooperate in the dissemination of information regarding soil survey progress and the value, use, and availability of soil survey information.
3. Provide guidance and assistance in other phases of the soil survey program.

D. The USDI Bureau of Land Management (BLM) will:

1. Participate in quality assurance reviews, field studies, and soil correlation for project soil surveys containing BLM lands.
2. Share available soil moisture and temperature, forestland, and rangeland data.
3. Cooperate in the conduct of the National Cooperative Soil Survey by allowing access to intermingled lands and by conducting soil surveys on the lands under the jurisdiction of BLM.
4. Provide guidance and assistance in other phases of the soil survey program.
5. Cooperate in ensuring exact joins between soil survey areas.

E. The USDI National Park Service (NPS) will:

1. Participate in quality assurance reviews, field studies, and soil correlation for project soil surveys containing NPS lands.
2. Cooperate in the conduct of the National Cooperative Soil Survey by allowing access to intermingled lands.
3. Share available soil moisture and temperature, forestland, and rangeland data.
4. Cooperate in ensuring exact joins between soil survey areas.
5. Provide guidance and assistance in other phases of the soil survey program.
6. Reimburse NRCS for the full cost of conducting soil surveys on the lands under the jurisdiction of NPS.

F. The Idaho Soil Conservation Commission will:

1. Contribute necessary personnel and equipment to help complete fieldwork of project soil surveys as agreed upon.
2. Participate in quality assurance reviews, field studies, and soil correlation.
3. Cooperate in information and education programs regarding the value, use, and availability of soil survey information.

4. Provide guidance and assistance in other phases of the soil survey program.

G. The College of Agriculture, University of Idaho; the Washington Agricultural Research Center, Washington State University; and the Agricultural Experiment Stations in Montana, Oregon, and Wyoming will:

1. Perform research in genesis, morphology, and classification of soils.
2. Participate in quality assurance reviews, field studies, and soil correlation.
3. Cooperate in information and education programs regarding the value, use, and availability of soil survey information.
4. Provide guidance and assistance in other phases of the soil survey program, including the development of appropriate soil survey products.

SPECIFICATIONS: The products expected are coordinated, joined, digitized soil surveys at 1:24,000 or 1:12,000 scales with accompanying attribute soil data in the National Soil Information System (NASIS). Digitizing specifications will be in accordance with the National Soil Survey Handbook Part 647 Map Digitizing Standards for SSURGO and Digital Map Finishing. Digitized data will not be copyrighted. NRCS reserves the right to archive and distribute data generated under the terms of this Memorandum of Understanding.

Sufficient field documentation will be collected to characterize and describe the map unit concepts as to name, composition, setting, and interpretation. Sufficient field checking of map units in the survey area will be made to ensure that delineations meet the map unit criteria - i.e., the map unit delineations are as described and their components will interpret as stated in the map unit descriptions and tables. The taxonomic classes selected to name map unit components will be represented and supported by a typical pedon. All surveys within this region will be coordinated and a comprehensive digital coverage developed through exact joins.

The program or activities conducted under this Memorandum of Understanding will be in compliance with the non-discrimination provisions contained in the Titles VI and VII of the Civil Rights Act of 1964, as amended; the Civil Rights Act Restoration Act of 1987 (Public Law 100-259); and other non-discrimination statutes, namely, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, and the Age Discrimination Act of 1975. They will also be in accordance with regulations of the Secretary of Agriculture (7 CFR-15, Subparts A & B), which provide that no person in the United States shall on the grounds of race, color, national origin, age, sex, religion, marital status, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving Federal financial assistance from the Department of Agriculture or any agency thereof.

APPROVAL

IDAHO

Signed________________________________ ______________________
State Conservationist — Date
USDA Natural Resources Conservation Service
Boise, ID

Signed________________________________ ______________________
Director — Date
USDI Bureau of Land Management
Boise, ID

Signed________________________________ ______________________
Regional Forester — Date
Region 4
USDA Forest Service
Ogden, UT

Signed________________________________ ______________________
Administrator — Date
Idaho Soil Conservation Commission
Boise, ID

Signed________________________________ ______________________
Dean — Date
College of Agriculture
University of Idaho
Moscow, ID

MONTANA

Signed______________________________ ____________________
State Conservationist — Date
USDA Natural Resources Conservation Service
Bozeman, MT

Signed______________________________ ____________________
Director — Date
USDI Bureau of Land Management
Billings, MT

Signed______________________________ ____________________
Regional Forester — Date
Region 1
USDA Forest Service
Missoula, MT

Signed______________________________ ____________________
Area Director — Date
USDI Bureau of Indian Affairs
Billings, MT

Signed______________________________ ____________________
Superintendent — Date
Glacier National Park
USDI National Park Service
West Glacier, MT

Signed______________________________ ____________________
Director — Date
Montana Agricultural Experiment Station
Montana State University
Bozeman, MT

OREGON

Signed________________________________ ____________________
State Conservationist Date
USDA Natural Resources Conservation Service
Portland, OR

Signed________________________________ ____________________
Regional Forester Date
Region 6
USDA Forest Service
Portland, OR

Signed________________________________ ____________________
Area Director Date
USDI Bureau of Indian Affairs
Portland, OR

Signed________________________________ ____________________
Director Date
Oregon Agricultural Experiment Station
Oregon State University
Corvallis, OR

WASHINGTON

Signed________________________________ ____________________
State Conservationist Date
USDA Natural Resources Conservation Service
Spokane, WA

Signed________________________________ ____________________
Director Date
Washington Agricultural Research Center
Washington State University
Pullman, WA

WYOMING

Signed________________________________ ________________________

State Conservationist — Date
USDA Natural Resources Conservation Service
Casper, WY

Signed________________________________ ________________________

Director — Date
USDI Bureau of Land Management
Casper, WY

Signed________________________________ ________________________

Regional Forester — Date
Region 2
USDA Forest Service
Lakewood, CO

Signed________________________________ ________________________

Superintendent — Date
Yellowstone National Park
USDI National Park Service
Mammoth Hot Springs, WY

Signed________________________________ ________________________

Director — Date
Wyoming Agricultural Experiment Station
University of Wyoming
Laramie, WY

Part 607 – INITIAL SOIL SURVEY PREPARATION

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Part 607 – INITIAL SOIL SURVEY PREPARATION

607.00 Purpose.

This part of the NSSH is focused on those soil survey projects that are being managed as initial soil surveys because they have either never been surveyed or, in rare instances, the existing survey requires such extensive revision as to require complete remapping. Soil survey update projects are addressed in part 610. The purpose of soil survey preparation is to ensure the efficient use of people and equipment and to meet the intent of the soil survey. The preparations help the project soil scientists to understand the intent and specifications detailed in the memorandum of understanding and the specific timeline and deliverables detailed in the plan of operation.

607.01 Policy and Responsibilities.

(a) The MLRA Region-wide memorandum of understanding

The MLRA Region-wide memorandum of understanding outlines technical standards and responsibilities of cooperators within the MLRA Soil Survey Region and is applicable to initial soil survey projects being conducted within the region.

(b) The soil survey project long range plan

The soil survey project long range plan (along with the project soil survey area memorandum of understanding, if one is used) specifies the deliverables and sets the time period to complete the soil survey. The time period specified for an initial soil survey project is recorded in the Soil Survey Schedule. Although initial soil surveys are planned and organized to complete a defined soil survey area, they are essentially a subset of the MLRA soil survey office and need to be managed within that larger physiographic context.

(1) Initial soil survey projects are scheduled for completion within about a 5-year period. Staffing should correspond to this scheduled completion period.

(2) Initial soil survey projects that will take longer than about 5 years to complete should be reconsidered in staffing or subdivided into more manageable areas.

(c) The State Soil Scientist

The State Soil Scientist provides administrative and management support and guidance to the office and staff and maintains and fosters relationships with the cooperators in the project.

(d) The MLRA Regional Office

The MLRA Regional Office provides technical support and guidance in preparing to conduct the survey in a coordinated fashion within the MLRA Region.

(e) The Soil Survey Project Office

The Soil Survey Project Office is responsible for:

(1) reviewing the MLRA Region-wide memorandum of understanding and the soil survey area memorandum of understanding (if applicable),

(2) preparing both long-range and annual plans of operation to complete the initial soil survey project,
(3) preparing and indexing the base maps (options may include contact print air photos, or DOQ images for on-screen digitizing, etc.),
(4) collecting and reviewing reference material, including digital data analysis,
(5) assembling equipment,
(6) making preliminary field studies,
(7) preparing an initial descriptive legend based on the field studies,
(8) initiating the collection of soil performance data to support soil interpretations,
(9) ensuring that map unit design meets program needs, and
(10) preparing to perform progressive correlation in a manner that ensures that the initial soil survey project is coordinated with the overall MLRA soil survey project.

607.02 Preliminary Survey Activities.

(a) Memorandum of Understanding and the Long Range Plan

(1) After the soil survey field staff has gained some familiarity with the survey area, the MLRA Region-wide MOU, long range plan and, if applicable, the local memorandum of understanding is reviewed jointly with the MLRA Regional Office, the state soil scientist, the line officer representing the lead agency, and representatives from each major cooperator. The following items are reviewed:
 (i) survey objectives and specifications;
 (ii) the role and function of each cooperating agency;
 (iii) the mapping base suitability in relation to landforms and soil complexity of the area;
 (iv) interpretation needs for regulations and programs;
 (v) needs for laboratory and soil investigations for soil classification and soil interpretations; and
 (vi) adequacy of plans to digitize, map finish, and electronically publish.

(2) If changes are needed later, the state soil scientist, MLRA Regional Office, or the appropriate supervisor of the lead agency is notified. If the state soil scientist, MLRA Regional Office, and appropriate supervisor concur, the long range plan and, where applicable, the memorandum of understanding for the survey area is amended as outlined in part 606.01(a)(6). The MLRA Region Board of Directors, or similar management body as applicable, will be consulted as necessary.

(b) Preparation of Aerial Photo Field Sheets (if used)

Use of digital map base materials is preferred for their inherent efficiencies, but in some instances paper copy aerial photo field sheets are used.

(1) The field sheets are properly identified to aid in their use and to ensure recovery of the sheets if they are lost. If the Natural Resources Conservation Service (NRCS) is the lead agency, each field sheet displays the following information:
 (i) USDA, Natural Resources Conservation Service, and the full name of the cooperating agencies;
 (ii) the total acreage of the soil survey area on the field sheet;
 (iii) the soil survey area name and state and field sheet number;
 (iv) a place for the names of the soil scientist(s) who mapped the sheet, the date(s), and the date that the field sheet was completed;
 (v) Soil Survey Project Office telephone number; and
 (vi) Project Leader's email address.

(2) The note "ADVANCE COPY SUBJECT TO CHANGE", the name of the soil survey area, the field sheet number, a bar scale, and a north arrow are placed on the front of all field sheets distributed to users.

(c) Preparation of Digital Data Mapping Base

(1) NRCS, USFS, NPS, BLM, or other lead agency will identify and acquire the appropriate spatial data layers necessary to create and maintain a soils map digitally.
- (i) Locate sources and obtain geospatial data for production soil survey.
- (ii) Check for correct spatial data extent (location).
- (iii) Review metadata for usability.

(2) Process and prepare those layers using appropriate map projections and file format conversions. All digital layers should be in the same:
- (i) coordinate system,
- (ii) quality standards,
- (iii) portable format, and
- (iv) scale.

(3) The MLRA Regional Office provides guidance on appropriate procedures to be used to ensure consistency in developing the geodatabase, naming and archiving files, and performing quality assurance activities. See Exhibit 607-2 for an example.

(d) Reference Material

Reference material is gathered, reviewed and summarized before the preliminary fieldwork begins. The kinds of reference material that may be available and useful are listed in Exhibit 607-1. Sources of reference material are:

(1) the U.S. Department of the Interior, Geological Survey, and state geological surveys or comparable state agencies with other names;
(2) the U.S. Department of Agriculture, National Agriculture Statistics Agency;
(3) the U.S. Department of Agriculture, Forest Service;
(4) the U.S. Department of Agriculture, Agriculture Research Service;
(5) the U.S. Department of the Interior, Bureau of Reclamation;
(6) the U.S. Department of Commerce, Bureau of the Census;
(7) the U.S. Department of the Interior, Bureau of Indian Affairs;
(8) the U.S. Department of the Interior, Fish and Wildlife Service;
(9) the U.S. Department of the Interior, Bureau of Land Management;
(10) the libraries of local schools, universities, municipalities, historical societies, and state agencies;
(11) local weather stations;
(12) the Crop Reporting Service;
(13) knowledgeable people such as faculty members of universities; representatives of the NRCS, Soil Conservation District, Cooperative Extension Service, and Farm Services Agency; vocational agriculture teachers; local representatives of planning boards, sanitation departments, and state and county highway departments; agricultural product dealers; state organization of professional soil scientists; and state and local geologists;
(14) local state data clearinghouses; and
(15) statue universities and colleges data sets.

(e) Assembly of Equipment

(1) The kinds and use of equipment are discussed in Chapter 4 of the Soil Survey Manual.

(2) A digital camera is necessary in all soil survey areas. The camera should be available to take photos when opportunities arise. Labeling and filing photographs in a systematic manner provide for easy retrieval.

(3) Office computers, scanners, plotters, field data collection and recording devices, and similar equipment improve and enhance data analysis, revision, and summary.

Exhibit 607-1 Reference Materials For Soil Surveys.

A. Soil Surveys in the MLRA

Older soil surveys of the current survey area and nearby areas
Soil surveys of adjoining areas
Soil surveys for conservation planning
Soil Survey Quality Control Data, including field notes and documentation
Soil Survey Quality Assurance Documents
Soil correlation memoranda and amendments

B. Reference Maps

Original field sheets
Major land resource area maps
General soil map
All available aerial photography and other remote sensing coverage
USGS topographic and slope maps
Public lands survey
Maps and text on geology, geomorphology, geography and water resources
Maps and text on vegetation and land use
Climatic maps and data
Flood plain maps
Maps and text on air resources
U.S. Fish and Wildlife Service wetland maps

C. Reports and Inventories

Census reports
Crop reporting service reports
Multi-spectral data
River basin reports
State, regional, or county land use plans and regulations
RC&D work plans
Public lands management reports and inventories
Bulletins and reports of State Agricultural Experiment Stations
National Food Security Act Manual and similar manuals
National Resource Inventory data
Field office technical guides
Soil Laboratory Data

D. Scientific and Research Reports and Data

Theses and dissertations of college or university students
International Taxonomy Committee reports - wet soils, cold Aridisols, Aridisols, Andisols
Articles in scientific and technical journals
Well logs from local or state agencies
NRCS drainage, irrigation, and erosion control guides and maps
Percolation test results from local agencies
Highway soil test data
Climate Data
Geomorphology Studies

E. Forestry, Range, and Wildlife Inventories and Studies

Forest inventories
Range inventories
Studies and reports on wildlife habitat recreational sites

F. Official Soil Series and Soil Interpretations

Soil interpretations information in the databases for the taxa assumed to be in the survey area
Official soil series descriptions
Archived copies of previous official series descriptions and soil interpretation records

G. Databases

Pedon database
National Soil Information System
Digital General Soil Map of the U.S.
Soil Survey Geographic (SSURGO) database

H. Digital Data

Digital Orthophotography
Digital Raster Graphic
Digital Elevation Model
Common Land Units
USFS Terrestrial Ecological Unit Inventories
Digital Hydrography, transportation, etc.
Digital remote sensing (LANDSAT, MODIS, etc.)

Exhibit 607-2 Example of a Procedure for Geodatabase Development, File Naming, Archiving, and Quality Assurance.

a) Geodatabase Development

1) Setup geodatabases with topology and import data layers.

- Use the standards for file naming
- Create geodatabase
- Import data into the geodatabase
- Project data to desired geographic location
- Create feature dataset
- Import template feature classes
- Set up domains

2) Set up the map environment for creating digital soils.

- Data
- Create a map and add data layers
- Customize a map:
  Toolbars and Menus
  Symbology
  Image display
- Create layer overview
- Add/delete field, calculate values
- Set selectable layers

3) Utilize various software in combination with appropriate data sets to accurately draft and revise soil mapping on screen.

4) Import, create, and display georeferenced information to validate soil map accuracy.

5) Create metadata to capture data sources and processes used in the development of digital mapping.

b) File Naming System

The geodatabase will be named in the following manner: state abbreviation followed by county or parish FIPS_OFFICIAL_current date, i.e., PG695_OFFICIAL_072105.

c) Archiving

In order to protect electronic data from accidental loss or software/hardware failure, the following archiving procedures will be implemented.

1) The project leader will establish an office archive procedure and communicate it to all soil scientists working on the project.

2) The project leader will add metadata notes, compact the geodatabase, and make a copy using the copy and paste function in ArcCatalog. The copy will then be renamed by changing "OFFICIAL" to "GIS" and adding the current date, i.e., PG695_GIS_072205.

3) The project leader will confirm that metadata notes are kept to capture scale of digitizing and imagery used. Brief metadata entries will be made in the Abstract section of the metadata in ArcCatalog for each geodatabase version that is sent for archiving. Notes in the Abstract and Purpose section could also be made for feature classes.

4) The following schedule should be followed to safeguard the geodatabase:

- **Daily**
  All new or edited soil mapping data will be backed up to hard drive storage at the soil survey office. This means that a separate copy of the geodatabase will be saved on a separate hard drive from the active file being edited.
  (i) It is also necessary to frequently save edits during an edit session in case the software crashes. Saving edits is different from saving the geodatabase.
  (ii) It is also necessary to frequently validate topology and fix errors while editing.
  (iii) Compact the geodatabases in ArcCatalog.

- **Weekly** – All new or edited soil mapping data will be burned onto a CD or DVD and stored offsite for security. Updates can be added to previous media in order to maintain an archive of edited versions.

- **Monthly** – When soil mapping data are being updated, send a copy of the geodatabase by compressing it into a WinZip file and sending as an email attachment (or on CD or DVD) to designated GIS staff. If no edits have been made this is not necessary.

- **Annually** – After completing a 100 percent quality control review of the digital data, the project leader will send a copy of the overall geodatabase to the MLRA Regional Office for quality assurance.

d) Quality Assurance

1) Project leader will complete a 100 percent quality control review of digital data, validate topology for the entire feature class, and fix identified errors. When the quality control review is completed, a copy of the geodatabase will be renamed, i.e., PG675_QA_current date, and then sent to the MLRA Regional Office for quality assurance.

2) Data Quality Specialist compares digital data with the field sheets during annual reviews or field assistance visits and discusses differences. For soil survey offices that use only digital mapping data, the review will evaluate landscape registration and map unit concepts. An additional brief review will be completed at the end of the survey.

3) The MLRA Regional Office will review monthly copies for quality of boundary line work and geodatabase properties.

4) Offices that have soil mapping on paper field sheets will have a 100 percent review of progressive digitizing when the soil survey is completed or when interim data are finalized.

Part 608 - PROGRAM MANAGEMENT

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Part 608 - PROGRAM MANAGEMENT

608.00 Definition and Purpose.

(a) **Definition**. Soil survey program management is the administrative phase of the National Cooperative Soil Survey (NCSS) that provides a systematic approach and guidelines for administering and coordinating soil survey activities.

(b) **Purpose**. Soil survey program management ensures the effective planning, scheduling, coordination, and organization needed to produce and maintain quality soil survey information, initiated as timely and as efficiently as possible. All initial, update, and Major Land Resource Area (MLRA) soil surveys are to be managed on a project basis.

608.01 Responsibilities and Organization.

This section describes the roles of the various offices within NRCS. Soil scientists and other specialists carry out soil survey activities at numerous management and technical support levels within the NRCS and through coordination with National Cooperative Soil Survey partners. Additional information about responsibilities at various levels of the organization can be found in the General Manual, Title 430, Part 402.

(a) **National Soil Survey Center (NSSC).**
The National Soil Survey Center includes five functional areas: Soil Survey Laboratory, Soil Classification and Standards, Soil Survey Technical Services, Soil Survey Investigations, and Soil Survey Interpretations. The National Leaders, under the direction of the NSSC Director or the Soil Survey Division Director, are responsible for functions in their respective areas; coordinating national technical standards, policy, and procedures that guide soil survey operations; training; investigations and laboratory assistance; and maintaining soil survey data and information systems, all in support of the National Cooperative Soil Survey program.

(b) **MLRA Regional Offices (MO).**
- (1) leads in the production and quality assurance of soil survey information;
- (2) leads in classification, correlation, and joining soil maps, interpretations, and data within and among MLRA soil survey areas;
- (3) provides quality assurance of maps, manuscripts, official series descriptions, and databases in the region; and
- (4) coordinates with federal lands agencies to assure that both NCSS standards and partner needs are met.

(c) **National Cartography and Geospatial Center (NCGC).**
- (1) assists in the acquisition and processing of aerial and orthophotography;
- (2) develops standards, specifications and provides quality assurance for spatial soil data capture;
- (3) prepares film negatives for soil survey maps;
- (4) coordinates soil survey publications;
- (5) maintains digital files of soil survey area boundaries for publishing and distributing graphics depicting status of soil surveys; and
- (6) provides assistance to the National Cooperative Soil Survey program in the development and application of new technology related to cartography, remote sensing, GPS, and geospatial data..

(d) National Geospatial and Development Center (NGDC).

(1) develops and integrates spatial science and technologies that bring the full wealth of soil and resource data and information to the user community;
(2) researches and develops technologies to improve the detail and accuracy of modern soil surveys and resource inventories;
(3) researches and develops field-based technologies for efficient data collection, database management, and mapping and analysis technologies, including spatial data mining, geostatistics, and multivariate spatial statistics;
(4) develops and tests web-based map services that improve information delivery;
(5) develops and tests information display systems that facilitate its interpretation, understanding, and use; and
(6) implements applications that are functional and user-friendly.

(e) State Offices.

As program managers, state soil scientists:

(1) advise and assist their state conservationist in allocating resources as effectively as possible to carry out both the soil survey and technical soil services in their state;
(2) provide technical soil services within their state;
(3) develop local soil interpretations;
(4) direct (and in some instances supervise) resource soil scientists;
(5) supervise MLRA soil survey office leaders unless the Board of Directors assigns supervision to the MLRA Regional Office Leader;
(6) develop cooperative relationships and serve as liaisons to the State Cooperative Soil Survey cooperators and to the MLRA regional offices;
(7) evaluate existing soil surveys, identify deficiencies, and incorporate needed improvements in the MLRA Soil Survey Office long-range plan of operations (see parts 610.03 and 610.04 for more details);
(8) monitor progress to ensure that work schedules and timelines are being met according to the plan of operations.
(9) develop schedules to meet soil survey program objectives and to assist the state conservationist in technical soil services activities for conservation operations; and
(10) in general, assist all users of soil survey information.

(f) Area and Field Offices.

Resource soil scientists and other specialists:

(1) provide coordinated soil information to all users;
(2) respond to user needs for new interpretations and collect performance data;
(3) evaluate the adequacy of soil survey information;
(4) provide support for USDA programs and to MLRA soil survey offices;
(5) assist field offices with technical soil services;
(6) update and maintain the field office technical guide; and
(7) train field personnel in the use of soil survey information.

(g) MLRA Soil Survey Offices.

(1) MLRA soil survey project leaders:
    (i) schedule routine work activities in plans of operations and monthly and weekly schedules, as appropriate, in consultation with the responsible state soil scientist and MLRA regional office;
    (ii) support updating of soil surveys within and among MLRA administrative areas;
    (iii) provide management and support of soil survey activities over a large geographic region;

(iv) keep soil survey maps and data throughout their assigned area current to meet the changing needs of users;
(v) improve the quality of digital line work to conform to the latest landscape models;
(vi) perform investigations throughout the MLRA(s), maintain soil survey datasets, and prepare and revise official series descriptions for processing;
(vii) conduct quality control of all soil survey activities in their area;
(viii) develop work plans and schedules;
(ix) supervise staff members; and
(x) conduct work in a manner that follows NCSS standards, policy, and procedure.

(2) Staffing
(i) soil scientists; and
(ii) in some instances, other professionals in related disciplines such as GIS, range science, etc.

(h) Soil Survey Project Offices.
These offices are established only with the concurrence of the Director of the Soil Survey Division, when there is a special need that cannot be met by the MLRA Soil Survey Office. In limited instances, where previously completed survey areas require extensive revision, a project soil survey office may be established as a subset of the MLRA Soil Survey Office. However, it is Soil Survey Division policy to transition all field operations into MLRA Soil Survey Offices as soon as is practical.

(1) Soil survey project leaders for initial surveys:
(i) schedule routine work activities in plans of operations and monthly and weekly schedules, as appropriate, in consultation with the responsible state soil scientist and MLRA regional office;
(ii) carry out mapping and related field data collections and investigations needed to complete initial soil surveys;
(iii) conduct quality control at the field level in a manner that follows NCSS policy, standards, and procedures; and
(iv) prepare maps, collect performance data, document map unit composition, develop and maintain databases, prepare taxonomic descriptions, and prepare manuscripts and tables to meet the requirements of the soil survey.

(i) Digitizing Units.
NRCS digitizing units are responsible for digitizing soils data, quality control of digital data, and certification review of final spatial data, including tabular data and metadata, for soil surveys. (see part 647).

(j) Digital Map Finishing Sites.
NRCS digital map finishing sites are responsible for the quality control and electronic preparation of soil maps for publication of initial and update soil surveys. (see part 647).

608.02 Soil Survey Area Designation.

(a) Definition.
(1) A soil survey area is a geographic (spatial) area that has a size and shape defined for efficient field operations and timely release of products. A soil survey area is an administrative unit for project management (staffing and equipment), progress reporting, and delivery of products.
(2) Soil survey area coverage includes all lands of the United States, Puerto Rico, the U.S. Virgin Islands, and the Pacific Basin Territories.
(3) Soil survey areas have a unique name and identification number registered in NASIS. Refer to part 608.03.

(4) MLRA soil survey areas follow physiographic boundaries reflecting natural features such as similar soils, geology, land use and climate. They are the basis for soil survey legend development to meet interpretive needs and for all related classification, correlation, and quality assurance functions.
(5) In some instances soil survey project areas are designed as subsets of MLRA soil survey areas to allow for completion of special projects (generally initial or extensive revisions) within about 5 years.

(b) Boundary Designation.
(1) Cooperating agencies of the National Cooperative Soil Survey designate the boundaries of soil survey areas in consultation with major users of soil information.
(2) The boundaries of MLRA soil survey areas generally encompass one MLRA, but may consist of more than one MLRA, or part of an MLRA where it is large in extent.
(3) The boundaries of project soil survey areas correspond to county boundaries, physiographic boundaries, tribal boundaries, federal agency management boundaries, or other land management areas.
(i) Two or more small counties may be combined to form the survey area; or
(ii) Large counties and physiographic areas may subdivide for efficiency of field operations and publication of a final product.

(c) Re-designating Soil Survey Areas.
(1) A large percentage of the nation has completed the initial soil survey. The boundaries used for these initial soil survey areas can be changed by the state soil scientist, in consultation with National Cooperative Soil Survey cooperators.
(2) Considerations for defining boundaries include:
(i) efficiency of managing legends and databases for different and overlapping spatial areas in the information system;
(ii) project management for extensive updating (personnel and equipment);
(iii) timely and efficient delivery of the final product; and
(iv) other factors important to cooperators.

(d) Small Geographic Areas.
(1) Special management areas such as small political subdivisions, areas of tribal lands, and federal management areas are ordinarily handled as special projects or subsets (overlaps) of a larger soil survey area.
(2) State soil scientists designate small geographic areas as soil survey areas.
(3) Refer to part 608.08 for guidance on legend administration and acreage management in the Soil Survey Schedule.

(e) National Coverage.
(1) For purposes of status graphics and soil business and program analysis, the National Cartography and Geospatial Center (NCGC) maintains a digital (spatial) layer of:
(i) all MLRA soil survey areas;
(ii) current initial soil survey areas;
(iii) update soil survey areas requiring extensive revision; and
(iv) original initial soil survey areas.
(2) State soil scientists coordinate boundary changes with the National Cartography and Geospatial Center as they occur. Refer to part 608.10.

608.03 Soil Survey Area Names and Symbols.

(a) Application of names.

Soil survey areas receive a unique name and identification number that is used in the National Soil Information System (NASIS), in cooperative agreements, memoranda of understanding, all survey area publications, correlation documents, and other official reports and correspondence.

(b) Registration.

The state soil scientist and MLRA Regional Office Leader coordinate the soil survey area names and symbols with the National Soil Survey Center for registration in the National Soil Information System. The name is not to exceed 135 characters.

(c) Identifying Soil Survey Areas in the Schedule.

(1) Soil survey areas use established conventions to identify soil survey areas in the Soil Survey Schedule. Each soil survey area receives a unique alpha-numeric identification code or "Area Symbol" that identifies the soil survey area data set in NASIS, as well as in the Soil Data Warehouse and Soil Data Marts.

(i) Soil survey areas that corresponds to a single county, parish, or independent city boundary: The symbol consists of the state abbreviation followed by the Federal Information Processing Standards (FIPS) code for the county, parish, or independent city.

(ii) For all other soil survey areas: Use the state abbreviation and assign a unique 600, 700, or 800 number in lieu of the FIPS code. The FIPS codes are in the Federal Information Processing Standards Publication Series of the National Bureau of Standards, U.S. Department of Commerce.

(2) Below are examples of names and symbols for soil survey areas that have differing boundary designations:

(i) MLRA Soil Survey Area corresponds to a single Major Land Resource Area. MLRA soil survey areas are identified by up to 7 characters; the prefix "SS" followed by the MLRA symbol and its subdivision, if necessary.

- Southern Blue Ridge (SS0130B)
- Red River Valley of the North (SS0056)

(ii) MLRA Soil Survey Area corresponds to multiple Major Land Resource Areas.

- Northern Coastal Plain and Northern Tidewater Area (SS0149A)
- Southern California Mountains and Southern California Coastal Plain (SS0020)

(iii) MLRA Soil Survey Area corresponds to parts of one or more Major Land Resource Areas.

- Atlantic Coast Flatwoods and Tidewater Area, Southern Part (SS0153A-1)
- Ontario-Erie Plain and Finger Lakes Region and Glaciated Allegheny Plateau and Catskill Mountains (SS0140-1)

(iv) Soil Survey Area corresponds to a single county boundary.

- Baldwin County, Alabama (AL003)
- Terrebonne Parish, Louisiana (LA109)

(v) Soil Survey Area corresponds to two or more county boundaries.

- Beaver and Lawrence Counties, Pennsylvania (PA603)
- James City and York Counties and the City of Williamsburg, Virginia (VA695)

(vi) Soil Survey Area includes only part of a single county.
Select a name that clearly distinguishes the survey area from other survey areas in the county, or from adjoining counties. If a clear designation cannot be made, use the term "Area" to indicate that the survey area boundary does not include the entire county.

- Nye County, Nevada, Southwest Part (NV785)
- Socorro County Area, New Mexico (NM664)

(vii) Soil Survey Area includes parts of two or more counties in one state.
Use the name of a well-known place or geographic feature, and list the counties.

- Jicarilla Apache Area, New Mexico, Parts of Rio Arriba and Sandoval Counties (NM698)
- Wenatchee National Forest, Naches Area, Washington, Parts of Kittitas and Yakima Counties (WA680)

(viii) Soil Survey Area includes all of one or more counties and part of another.
- Soil Survey of Curry County and Southwest Part of Quay County, New Mexico (NM669)
- Menifee and Rowan Counties and Northwestern Morgan County, Kentucky (KY632)

(ix) Soil Survey Area includes parts of two or more counties in adjoining states.
- Duck Valley Indian Reservation, Idaho and Nevada (ID677)
- Duck Valley Indian Reservation, Idaho and Nevada (NV798)
- Great Smokey Mountains National Park, Tennessee and North Carolina (TN640)
- Great Smokey Mountains National Park, Tennessee and North Carolina (NC640)

Note: In order to maintain acreage integrity for all states, separate Legend entries are made in the Soil Survey Schedule for survey areas that cross state boundaries.

(x) Soil Survey Area in a region with no counties. Use the name of a well-known place or geographic feature in the area.
- San German Area, Southwestern Puerto Rico (PR787)
- North Star Area, Alaska (AK642)

608.04 Limited and Denied Access Areas.

(a) Limited Access Areas.

(1) Soil survey area coverage includes all lands (refer to part 608.02), and the goal of the National Cooperative Soil Survey is to survey all lands. Many survey areas include parts that have difficult or limited access to personnel conducting field operations, and occasionally landowners deny access to their property.

(2) Do not necessarily exclude land from a soil survey area based on difficult or limited access or because of difficulty in obtaining permission to gain access. Use all available resources, such as old soil survey maps (if available), geology and topographic maps, aerial photography, and other available remote sensing materials to apply common field procedures and techniques to delineate map units.

(i) For relatively small areas, mapping surrounding lands and projecting soil lines across the area of denied access may be feasible.

(ii) For relatively large areas, more broadly defined map units may be appropriate. In these cases, describe the reduced reliability in the map unit description.

(b) Surveying Denied Access Areas.

State soil scientists, in consultation with the state conservationist and local cooperators, determine the feasibility of mapping areas of denied access. Reliability of the mapping for anticipated use and interpretations should be the final determining factor.

(1) Judgment should be used in deciding whether to attempt to gain permission to map areas of denied access. In some instances, such as areas restricted for national security purposes or where there is a desire by Native American officials for some tribal lands to remain unmapped, the decision may be made to not pursue the issue further.

(2) In situations other than those described in (1) above, use all reasonable means to obtain permission to map. Enlist the aid of community leaders, district cooperators and supervisors, county and state officials, and others, as appropriate.

(3) If reasonable efforts to gain access are unsuccessful, apply techniques and resources discussed above in part 608.04(a) to map the area.

(c) Reporting Denied Access Areas.

(1) Delineate the area as a map unit with a name "Area not surveyed, access denied."

(2) In the map unit description, tactfully describe the rationale for not mapping the area.

(3) Include the symbol and the acreage in the soil survey acreage table of the final report.

(i) Acreage is reported as mapping progress using standard progress reporting procedures.

(ii) In rare instances where the area of denied access is very large, the soil survey area may be revised to exclude the unmapped area. Acres are not reported.

(d) General Soil Maps.

Whether or not areas are excluded from detailed mapping, do not exclude areas from the general soil map for the survey area and the U.S. General Soil Map (STATSGO2) database. Use standard procedures for delineating general soil map and STATSGO2 map units. The STATSGO2 map is the basis for the survey area general soil maps.

608.05 Determining Workloads.

(a) The **NRCS General Manual Title 340** describes agency policy for workload analysis. Other cooperating agencies have their own policy for workload analysis.

(b) The workload analysis planning process.

The workload analysis planning process considers the work to be done, estimates the amount of time required to complete each task, and provides a timetable for completing the work.

(1) A workload analysis – long-range plan for the MLRA soil survey office considers all aspects of bringing all soil surveys in the area to a common standard to meet user needs. (See Exhibit 608-3). In addition to the needs of the private lands in the area, it should include the needs identified by the cooperators responsible for the federal lands within the area so that a coordinated effort is achieved in all soil survey work.

(2) An MLRA soil survey office Project Plan of Operations is used for planning to accomplish one or more of the highest priority needs within about a 2 to 5 year period. (See Exhibit 608-4).

(c) Prepare a workload analysis for a project soil survey (initial soil survey) before the soil survey begins.

Exhibit 608-1 gives a sample format for a long range plan for initial soil survey projects (or update soil surveys requiring extensive revision).

608.06 Priorities for Soil Surveys.

(a) State cooperative soil survey conferences convene annually to discuss soil survey activities, consider the priorities of all cooperators, and recommend action. Other interested user groups recommend priorities, such as for special or interim soil reports. Considerations for preparing the priority list are:

(1) status of initial soil surveys and update soil surveys requiring extensive revision,
(2) NRCS needs for carrying out technical assistance programs and projects,
(3) cooperating agency needs for meeting their program and project needs,
(4) requests for soil surveys by local people,
(5) needs of federal partners on federal lands,
(6) needs for information that aids in land use planning and decisions,
(7) rapid land use changes in areas where critical soil problems are expected,
(8) contributions of funds or staffing,
(9) needs for tax evaluation, and
(10) other factors of specific local importance.

(b) State soil scientists, lead scientists of cooperating partners, the MLRA Regional Office leader, and the MLRA Soil Survey Office leader work with the above information to establish priorities for each MLRA Soil Survey Area. Where federal lands are included within the MLRA soil survey area, it is important to coordinate with appropriate representatives of those agencies.

(c) Priorities are incorporated into a workload analysis – long-range plan and reviewed and concurred-upon by state conservationists and cooperating partners.

(d) The workload analysis – long-range plan may be revised periodically as work progresses and new information or unforeseen circumstances arise. Additional issues to be addressed may come from a variety of sources, such as Resource Soil Scientists, field offices, cooperators, customers, the MO, or State Soil Scientists. Reports from the Soil Data Mart or NASIS may also reveal issues and deficiencies to be prioritized and addressed.

(e) Give consideration to the lead time required to prepare the geospatial data and analyze existing information.

608.07 Planning Workflow.

The MLRA soil survey project plan of operations directs the use of resources over a period of about 2 to 5 years to accomplish identified activities. This is required for all MLRA soil survey projects. The plan identifies the activities that are to be accomplished during the time period covered by the plan. The plan includes the responsibility for each activity, projected completion dates, and goals.

Exhibits 608-1 through 5 show sample formats for workload analysis, project plans, and for annual plans of operations for initial or update soil surveys requiring extensive revision and for MLRA soil surveys. Adapt them to fit the needs identified for the project area.

Part 610.02 contains information about workflow for updating by MLRA soil survey area.

608.08 Soil Survey Schedule.

(a) Definition.

The Soil Survey Schedule is a program management tool within the National Soil Information System (NASIS) for planning, managing, and tracking status, milestone events, and progress of the National Cooperative Soil Survey.

(1) Program managers use information in the Soil Survey Schedule to assess workloads, develop activity schedules and budgets, and plan for resources needed to complete the national soil inventory and related databases.
(2) The schedule lists all non-MLRA soil survey areas in NASIS, as defined in parts 608.02 and 608.03.
(3) Legends for each survey area contain administrative and other data that track the key business processes of the survey from field data collection through final publication.
(4) Various soil survey business areas populate progress in the schedule related to their individual areas of responsibility, and use information from the schedule to plan and manage their operations. See 608.08(b) (4) for a list of soil survey business areas.

(b) Responsibilities.

Data stewards for the various soil survey business areas are responsible for populating data elements and ensuring data quality in the Soil Survey Schedule. Soil survey business areas include all inventory-related activities at the field level, and support and enabling activities for generating soil survey products.

(1) The business area responsible for either initiating or completing a soil survey business process also is responsible for populating appropriate data elements and reporting progress associated with the process.

(2) Exhibit 608-7, Soil Survey Schedule Business Area Responsibilities, identifies broad soil survey business processes, along with associated data elements and the business area that is responsible for populating the schedule. Some data elements in Exhibit 608-7 indicate more than one responsible business area; for these situations, the appropriate business area program managers designate the responsible data steward.

(3) State and MLRA Regional Office program managers may delegate responsibility to populating some data elements to the field. For example, project soil survey offices may be designated to report mapping and compilation progress for their survey area.

(4) Designated business areas and key Soil Survey Schedule responsibilities are:

- (i) **State Offices** – Legend administration, identify imagery, orthophotography, digital elevation models (DEM) and other base map materials, and coordinate mapping goals and progress reporting for soil survey areas with the MLRA Regional Office.
- (ii) **MLRA Regional Offices** – legend administration for MLRA soil survey areas, progress related to field reviews and correlations, and reporting compilation certification status.
- (iii) **National Soil Survey Center** – NASIS technical support, coordination with Information Technology Center, maintenance of area symbols and acreage, and soils hotline.
- (iv) **National Office** – policy and guidance for soil survey program, including fund allocations, progress reporting, and Soil Survey Schedule oversight.
- (v) **Digitizing Units** – SSURGO digitizing and certification reviews.
- (vi) **Digital Map Finishing Sites** – digital map finishing for soil surveys.
- (vii) **National Cartography and Geospatial Center** – soil survey program support for imagery and orthophotography acquisition, map compilation materials, publication of soil survey products, distribution of SSURGO (Gateway), SSURGO and digital map finishing standards, status graphics, and digital elevation models and geospatial web services.
- (viii) **Editors** – English edit of manuscripts.

(c) Accessing the Soil Survey Schedule.

(1) The Soil Survey Schedule and soil survey area legends are accessible through the conventional National Soil Information System interface.

- (i) The interface provides authorized users with full capability to create, edit, and report data.
- (ii) Individuals accessing the data in this way need to be extremely careful not to populate or change data that falls under the responsibility of another business unit.

(2) Access is also available via a web-based application that provides authorized users with limited capability to manage data and generate programmed reports.

- (i) Web access is at: http://ssschedule.nrcs.usda.gov.
- (ii) A web login and password can be obtained by contacting the soils hotline at (402) 437-5378 or by email at: hotline@lin.usda.gov.

(d) Schedule Management.

Exhibit 608-7 identifies soil survey business areas and related data elements, including key terminology and protocols, necessary for administration and maintenance of the schedule. Exhibit 608-7 provides an overview of the data elements and responsible soil survey business areas in the schedule.

(e) Soil Survey Performance Measurement.

The NRCS Performance Results System (PRS) is the official progress reporting instrument used by the agency to prepare national-level reports. Agency-accountable items such as soil mapping progress, first-time archival of SSURGO digitizing, and public release of soil surveys are assembled from the Soil Survey Schedule and the Soil Data Mart nightly and automatically uploaded to the PRS. Goals for these agency-accountable items are also taken from NASIS and recorded in the PRS.

Other data from the Soil Survey Schedule is used to assess program performance and analyze budgets. Examples include signed memoranda of understanding, progress reviews and correlations completed, manuscripts edited, acres compiled and digitized, and the status of imagery and orthophotography acquisition. Both individual and business area performance can be analyzed.

(1) Performance Goals.

(i) At the beginning of the fiscal year, establish individual and team goals for soil survey business functions.

(ii) In addition to initial and update soil surveys, mapping goals may be set for non-project survey areas based on anticipated requests for conservation planning. Refer to Exhibit 608-6 for more discussion about goal setting.

(iii) State program managers and supervisors:

- Base performance goals on the individuals' job description, experience, training, complexity, and other factors;
- Monitor progress throughout the year; and
- Revise individual or team performance goals as needed, in consultation with the employee(s).

(iv) Set performance goals for:

- technical services and soil survey support activities;
- mapping goals – do not include large water bodies (census water); however, report census water acres as a land category administrative action;
- database development;
- correlations; and
- manuscript development.

(2) Progress and Progress Reporting.

(i) Soil survey progress records the inventory of the nation's soil resources, development of related databases, soil survey products, and interpretative materials.

(ii) Soil survey program managers are responsible for ensuring that progress is reported.

(iii) Reportable items include all activities, including intermediate products that lead to a final product meeting National Cooperative Soil Survey standards.

- acres mapped;
- correlations completed;
- acres compiled and digitized; and
- manuscripts edited.

(iv) Report progress in the Soil Survey Schedule as it occurs. **As a minimum, report mapping progress quarterly**, and all other progress monthly.

(3) Mapping Progress.

(i) Refer to Exhibit 608-6 for more discussion about reporting mapping progress.

(ii) Discuss progress reporting issues with the Soil Survey Schedule manager in the Soil Survey Division Headquarters <u>before</u> revising.

- For each soil survey area, enter mapping progress into the schedule by land category (refer to acreage accountability below).
- The reporting date entered in the Legend Mapping Progress Table determines the fiscal year for which progress is counted.
- Report progress as initial or update mapping.
- Distinguish NRCS from cooperator personnel.
- Enter each individual's progress (preferable) or the project team's as a whole.
- Initial soil surveys are closely monitored (i.e., once-over surveys). Report initial mapping progress only once and never delete it from the system once it is reported, except for data entry errors that are immediately recognized and corrected.

- Upon completion of the initial soil survey, all initial acres that are reported as progress should equal the land category acres and the sum of all land category acres should equal the soil survey area acres.

(f) Legend Administration and Acreage Management.

The National Soil Information System (NASIS) provides a variety of ways in which legends can be managed. Therefore, in order for the system to function optimally, a uniform approach is required.

Soil survey area legends that are linked to Non-MLRA Soil Survey Areas provide data for the Soil Survey Schedule. The Schedule accommodates multiple legends for the same (spatial) survey area, or for overlapping survey areas; however, the schedule only maintains the official legend and any legacy legend(s) for survey areas. Copies of official legends can be linked to a locally created area type. However, these types of legends are not to be linked to the Non-MLRA Soil Survey Areas owned by Pangaea.

(1) Unique Spatial Areas.

(i) All survey areas represent a unique geographical (spatial) area, i.e., an entire county; they receive a unique area symbol and area name (see parts 608.02 and 608.03).

(ii) Legends that represent the same geographical area use the same area symbol and area name.

(iii) For survey areas having multiple legends, the soil survey area status identifies the most current legend, as discussed in 608.08(d).

(iv) Exhibit 608-6 provides additional discussion and examples of various legend scenarios and protocols.

(2) Acreage Accountability.

NRCS annual congressional appropriations are limited to non-federal lands, including Tribal and Trust Territories. The cost of soil survey activities by NRCS on federal lands must be reimbursed to the agency. However, the NRCS as federal lead for the National Cooperative Soil Survey maintains records of soil survey mapping for all lands of the nation.

(i) Seven land categories distinguish between non-federal and federal ownership. Additionally, federal lands are categorized according to the responsible federal land management agency.

- Native American land
- Other non-federal land
- Bureau of Land Management
- U. S. Forest Service
- National Park Service
- Other federal land
- census water

(ii) Refer to Exhibit 608-6 for definitions of the land categories and for additional discussion of acreage management and accountability.

(3) Acreage Allocation.

Federal and private land ownership and their acreages constantly change. State program managers must periodically access land ownership for all soil survey areas.

(i) If ownership acres have changed in a soil survey area:

- Re-allocate acreage assigned to the seven land categories.
- Re-allocate progress assigned to each land category.

(ii) The sum of all land category acres equals the state-total 1992 National Resource Inventory.

(iii) To re-allocate acres for soil surveys with more than one legend or that partially overlap with another survey, refer to the discussion of acreage management and accountability in Exhibit 608-6.

(4) Acreage Base.

County-based 1992 National Resources Inventory (NRI) data for total surface area (land and water) is used within NRCS for soil survey areas.

(i) Use the exact county-based figures or round to the nearest hundred.

(ii) Coordinate acreage assigned to all survey areas with the National NASIS data steward at the National Soil Survey Center for inclusion in NASIS.

(g) Soil Survey Area Status.

The objective of the soil survey program is to complete the initial soil survey and to improve current interpretative and spatial soil survey information through an active evaluation and update program. The goal is to reduce the number of surveys that are out-of-date or that are designated as update needed at any given time. Refer to part 610 for additional discussion of updating soil surveys and for a sample evaluation sheet.

Seven categories identify the operational activity status of soil survey areas and currency of published soil information for non-MLRA soil surveys. Program managers use status to identify workloads and ongoing field activities, for tracking progress, and for making graphic displays. The status assigned to soil survey areas containing federal lands is made in consultation with the federal partner agency.

Soil survey area status categories and their definitions are:

(1) Non-project.

(i) Defined:

- initial mapping incomplete;
- no signed correlation document;
- staffing not assigned to complete the initial mapping and field documentation within 3 to 5 years;
- soil mapping on individual tracts, as requested for conservation and resource planning;
- soil mapping and documentation meet NCSS standards, just like initial and update surveys;
- "non-project" is the status designation assigned to survey area legends in the Soil Survey Schedule.

(ii) Requirements:

- a soil survey area handbook that includes a provisional descriptive legend (see part 627) containing a list of map units from within the MLRA and soil interpretations generated from NASIS;
- field reviews held at least once every 3-5 years to ensure that mapping and interpretative materials meet National Cooperative Soil Survey standards;
- technical assistance upon request.

(2) Initial.

(i) Defined:

- a signed MLRA region-wide memorandum of understanding (MOU) and other local memoranda, as appropriate (see part 606);
- staffing is assigned to complete the initial mapping and field documentation within 3 to 5 years;
- "non-project" is changed to "initial" status on the existing Legend in the Soil Survey Schedule when the memorandum of understanding is signed and staffing is assigned.

(ii) Requirements:

- a long range plan details the activities needed to complete the project in approximately 2 to 5 years;

- soils are mapped in contiguous blocks using map units from surrounding surveys within the MLRA;
- a soil survey area handbook includes a descriptive legend (see part 627) and soil interpretations generated from NASIS as progressive correlation proceeds;
- routine quality assurance reviews by the responsible MLRA Regional Office and field assistance by the appropriate entity;
- progressive soil correlation with adjacent surveys within the MLRA;
- high quality digital orthophotography base maps, digital elevation models (DEMS), and other base maps for digital soil survey mapping, and where needed, high quality imagery for field investigations;
- mapping on hard copy aerial photography, subsequently compiling to orthophotography, and hand- or scan- digitizing are avoided if at all possible. Field mapping is done using electronic media and on-screen digitizing as much as possible to avoid these extra steps.
- Results in a signed correlation document

(3) Published.

(i) Defined:

- a traditional hard copy printed report, CD-ROM, DVD, web publication, or other media as agreed to by National Cooperative Soil Survey cooperators in the memorandum of understanding or project plan and issued by a federal or state agency that meets the current needs of users;
- change the survey area status from "initial" to "published" on the existing Legend in the Soil Survey Schedule when the end publication product specified in the project plan is available.

(ii) Requirements:

- correlation document signed by the NRCS, based on Soil Taxonomy at the time the soil survey was published;
- soil maps;
- map unit and taxonomic unit descriptions;
- soil interpretations generated from NASIS;
- a populated, certified data set as part of the national soil database.

(iii) Periodic updating – published surveys require various degrees of periodic updating:

- when only new or revised soil interpretations are needed, retain "published" status;
- add the interpretations supplement to the published report.

(4) Out-of-Date.

(i) Defined:

- a published soil survey that no longer meets users' needs and requires extensive revision to the soil maps as defined in part 610.04(a)(2)(i);
- a comprehensive evaluation documents deficiencies for the entire survey area and National Cooperative Soil Survey cooperators agree on the evaluation;
- the published soil survey is not targeted for immediate project soil survey activities.

(ii) Requirement:

- change the survey area status from "published" to "out-of-date" on the existing Legend in the Soil Survey Schedule.

(5) Extensive Revision.

(i) Defined:

- a published soil survey that requires extensive revision, above and beyond normal MLRA soil survey project updating as described in part 610.04. Few surveys completed after about 1975 are expected to require this level of update;
- an evaluation file identifies the needed revisions and maintenance;

- The survey area has a signed MLRA Region-wide or local memorandum of understanding and staffing to complete the fieldwork within about 3 to 5years.

(ii) Requirements:

- written permission from the Soil Survey Division Director to conduct an extensive revision;
- a long-range plan detailing all activities needed to complete the work within about a 5 year period;
- change the survey area status to "extensive revision" on the existing Legend in the Soil Survey Schedule.
- Legend management of the map units are the same as for initial soil surveys. Map units are added with a status of "provisional," progress to "approved," and then are eventually "correlated" <u>when the spatial data is certified, the NASIS data is certified and both databases are ready to send to the Soil Data Warehouse</u>;
- Assign a status of "additional" to old map units that are replaced by new map units;
- Refer to Exhibit 608-6 for additional guidelines on balancing land category acres and State National Resource Inventory acreage accountability.

(iii) Additional characteristics of an extensive revision survey area include:

- complete, systematically collected field data for the entire survey area;
- re-mapping, as required, is based on the evaluation and memorandum of understanding;
- a soil survey area handbook includes a descriptive legend (see part 627) and soil interpretations generated from NASIS;
- routine quality assurance reviews are conducted by the responsible MLRA Regional Office, and field assistance by the appropriate entity;
- progressive soil correlation with adjacent surveys within the MLRA;
- updated correlation decisions are recorded in NASIS;
- the most current Keys to Soil Taxonomy is used;
- high quality digital orthophotography base maps, DEMS, and other base maps for digital soil survey mapping, and, where needed, high quality imagery for field investigations;
- mapping on hard copy aerial photography, subsequently compiling to orthophotography, and hand- or scan- digitizing are avoided if at all possible. Field mapping is done using electronic media and on-screen digitizing as much as possible to avoid these extra steps;
- updated maps, data, and interpretations are distributed through the Soil Data Mart and Web Soil Survey;
- change the status of the legend to "published" when the final product specified in the memorandum of understanding is available.

(6) Update Needed.

(i) Defined:

- a comprehensive evaluation documents deficiencies for the entire survey area and National Cooperative Soil Survey cooperators agree on the evaluation;
- at least part of the soil survey area needs revision (primarily to the soil maps);
- along with needed changes to the soil maps, the survey generally requires new or revised interpretations;
- the published soil survey is not targeted for immediate project soil survey activities;
- the needed revisions are primarily to the soil maps. See section 610.04(a)(2) for further discussion of each category:
  (a) update,
  (b) modernize the soil base map, or
  (c) supplemental soil mapping.

(ii) Requirement:

- change the survey area status from "published" to "update needed" on the existing legend in the Soil Survey Schedule.

(7) Update.

(i) Defined:

- a soil survey with prior "published" or "update needed" status in which staffing is now available to complete the work;
- change the survey area status from "published" or "update needed" on the existing legend in the Soil Survey Schedule to "update" when staffing from the MLRA soil survey office is assigned to complete the work;
- a new legend in the Soil Survey Schedule is not needed;
- revised maps and data are periodically posted to the Soil Data Mart and Web Soil Survey.

(ii) Requirements:

- update activities neither require an memorandum of understanding nor result in a new correlation document;
- an evaluation file identifies the needed revisions and maintenance;
- correlation decisions that improve the coordination and joining of soil maps and data within the MLRA are recorded in NASIS;
- legend management of the map units are the same as for initial soil surveys. Map units are added with a status of "provisional," progress to "approved," and then eventually are "correlated" when the spatial data is certified, the NASIS data is certified and both databases are ready to send to the Soil Data Warehouse;
- revised or supplemental mapping progress is reported on the existing legend as "update mapping;"
- a workload analysis – long-range plan of operations;
- revisions documented in the original publication;
- analysis of existing soil descriptions; laboratory data, and other field data to the extent practical;
- complete, systematic collection of additional field data as required, are based on the disposition of existing data and the initial evaluation of update needed;
- routine quality assurance reviews are conducted by the responsible MLRA Regional Office, and field assistance by the appropriate entity;
- high quality digital orthophotography base maps, DEMS, and other base maps for digital soil survey mapping, and, where needed, high quality imagery for field investigations;
- mapping on hard copy aerial photography, subsequently compiling to orthophotography, and hand- or scan- digitizing are avoided if at all possible. Field mapping is done using electronic media and on-screen digitizing as much as possible to avoid these extra steps;
- distribution of updated maps, data, and interpretations through the Soil Data Mart and Web Soil Survey;
- change the status to "published" when all work is complete.

608.09 Developing Other Schedules for Soil Survey Operations.

(a) Soil Survey Operations.

Schedules and timelines for soil survey activities are detailed in project plans of operations, annual plans of operation, and monthly or weekly schedules. Exhibit 608-1 identifies the basic activities that must be completed for initial surveys. Exhibit 608-4 is an example of potential activities that may be planned for MLRA soil survey projects.

(1) Soil survey project leaders schedule soil survey activities and coordinate routine work in consultation with the responsible state soil scientist and MLRA Regional Office.

(2) MLRA Regional Offices schedule quality assurance reviews and field assistance visits in consultation with the project offices, state offices, and National Cooperative Soil Survey partners.

(b) Technical Soil Services.

(1) State offices and field offices develop annual plans of operation and monthly or weekly schedules, as appropriate, for technical soil services-related activities.

(2) Resource soil scientists and, in some instances, other soil scientists assigned to nearby soil survey project offices provide soil information as needed for conservation planning and other special local needs. These efforts ensure efficient use of soil scientist time and timely delivery of soil information.

(c) Individual Schedules.

(1) Individual soil scientists prepare monthly or weekly schedules, as required by supervisors.

(2) These schedules include
- (i) routine soil survey activities;
- (ii) training to be given and received;
- (iii) staff conferences; and
- (iv) information and public relations needs.

608.10 Status Maps.

Maps indicating the progress and status of soil surveys and soil survey products are important management and public relations tools. Maps may be on a national, regional, MLRA region, and state basis.

(a) Source Data.

(1) The primary source of attribute data is the Soil Survey Schedule. Part 608.08 identifies soil survey business areas that are responsible for populating and maintaining the Soil Survey Schedule.

(2) Base map cartography and spatial data for soil survey areas is maintained by the National Cartography and Geospatial Center (NCGC).

(b) Responsibilities.

(1) The National Cartography and Geospatial Center:
- (i) publishes and distributes status maps;
- (ii) maintains a digital file of soil survey area boundaries for all legends listed in the Soil Survey Schedule. Boundaries are taken from SSURGO data archived on the Soil Data Mart.

(2) State Soil Scientists:
- (i) assure the accuracy and completeness of other survey area boundaries;
- (ii) initiate revisions and corrections.

(c) Availability.

Visit the NCGC site at http://www.ncgc.nrcs.usda.gov for maps in various formats that indicate the status of soil surveys and soil survey digitizing.

(1) Status of Soil Surveys Map.

The status of soil surveys portrays a map of the status of all non-MLRA soil survey areas in the United States and its Trust Territories. This map is typically updated at the beginning of each fiscal year. Map legend categories include the status codes for survey areas, as defined in part 608.08, and other progress data in the Soil Survey Schedule.

(i) Standard map legend categories, colors, and a brief description.
- **Published** (dark green): subset publication issued, and it meets user needs.

- **Initial, Field Mapping In-progress** (yellow): memorandum of understanding signed for the initial subset comprehensive survey, project leader and staff assigned, mapping and related field activities underway.
- **Initial, Field Mapping Complete** (light green): subset mapping and field data collection complete, correlation, manuscript development, and map finishing underway.
- **Extensive Revision, Field Work In-progress** (light blue): long range plan of work developed for a previously published subset survey, project leader and staff assigned, field data collection and/or mapping underway.
- **Extensive Revision, Field Work Complete** (orange): field data collection and/or subset mapping complete, correlation, manuscript development, and map finishing underway.
- **Out-of-Date** (red): an evaluation documents that published report no longer meets user needs; extensive revision field work needed and will result in a new subset correlation and publication.
- **Update Needed** (light goldenrod): an evaluation documents that parts (primarily maps) of the published report require revisions; plans for updating incomplete.
- **Update In-Progress** (dark khaki): an evaluation documents that parts (primarily maps) of the published subset report require revisions; staffing assigned and work underway.
- **Non-project** (white): plans for a comprehensive project survey incomplete.

(ii) Additional information on the map includes:

- **Date**: Status as of "mm/yy"
- **Legend Count and Percent**: Total number of surveys in each legend status and percent of total area

(2) Status of Soil Survey Digitizing (SSURGO) Map.

The Status of Soil Survey Digitizing (SSURGO) map portrays progress of the National Digitizing Initiative. Digital soil data for surveys under this initiative is a high priority for national and local users. This map is updated monthly by the National Cartography and Geospatial Center. The map shows progress toward SSURGO certification and archiving, as outlined in part 647. Surveys authorized as a digitizing initiative should be SSURGO certified within one to two years.

Map legend categories cite milestone events in the SSURGO development process, and status reflects progress data recorded in the Soil Survey Schedule.

(i) The standard map legend categories, official ARC/INFO colors, and a brief description are:

- **Authorized Initiative** (BURLYWOOD [a light brown]): soil survey funded for SSURGO development from special national allocations; or, the survey is a state priority without special national funding and authorized by the Director, Soil Survey Division.
- **Compilation in Progress** (LIGHT SKY BLUE [a pale blue]): compilation of polygons and special features underway.
- **Compilation Complete** (CYAN [a bright blue]): compilation of polygons and special features complete, and certified by the MLRA regional office.
- **Digitizing Complete** (TOMATO [a pale orange red]): digital data capture complete for all spatial (area, point, linear) data. Survey ready for quality control review (check plot review and error correction).
- **Digital Review in Progress** (GOLD [a dark yellow]): SSURGO review process underway. The spatial data, attribute data, metadata, correlation document, and compilation certification for a SSURGO initiative on file at an NRCS Digitizing Unit.
- **SSURGO Archived** (GREEN YELLOW [a light green]): all digital data capture, attribute data, and metadata complete; survey passed a SSURGO certification review by an NRCS digitizing unit, and certified by an MLRA regional office and state

conservationist; survey archived and available for distribution on the Soil Data Mart and Web Soil Survey.

(ii) Additional information on the map includes:

- **Legend Title**: "Initiative Status as of mm/dd/yy"
- **Count**: Total number of authorized SSURGO initiatives in each legend status
- **Total**: Total number of authorized SSURGO initiatives

(3) Other Status Maps.

Program managers at the national, regional, MO region, or state levels may determine other types of soil survey status maps useful for management and information purposes within their operational area.

Exhibit 608-1 Long-Range Plan of Operations for Initial Soil Surveys and for Update Soil Surveys Requiring Extensive Revision.

United States Department of Agriculture - Natural Resources Conservation Service

____________________ County, ____________________________________

Date _________________ Project staff ____________________________________

Narrative of Plan Items	FY-	FY-	FY-	FY-	FY-
1. Memo of understanding (optional with MLRA region-wide MOU on file)					
a. Meet with locals					
b. Prepare draft MOU					
c. Obtain review					
d. Obtain signatures					
2. Collect references					
a. Geology					
b. Water resources					
c. Statistical reports					
1. Farm					
2. NRI					
3. SWCD					
4. Climate					
5. Other					
d. County roads					
e. Adjoining soil survey data					
f. Topo quad sheets , DEM's					
3. Prepare field sheets (if used)					
a. Edging					
b. Identification					
c. Advance copy ident.					
d. Acreage determination					
e. Other					
4. Preliminary field studies					
a. Area reconnaissance					
b. Develop landform map					
c. Field test STATSGO2 for GSM use					
d. Test map areas					
e. Correlate studies and field observations					

5. Prepare draft descriptive legend (ensure NASIS is populated for)					
a. Taxonomic desc.					
b. Map unit desc.					
c. Features and Symbols legend					
d. Identification legend					
e. Classification of soils					

Narrative of Plan Items	FY-	FY-	FY-	FY-	FY-
6. Documentation and supporting data					
a. Transect studies					
b. Field notes					
c. Identify problem areas					
d. Field descriptions					
e. Pedon program					
f. Transect program					
g. Soil mapping procedures relationships, soil surveyor's model					
h. Other					
7. Special studies					
a. Crop yields					
b. Forestland site					
c. Geomorphic					
d. Characterization					
e. Surficial geology					
f. Other					
8. Field mapping					
a. Joining					
b. Acreage goals					
c. Compile sheets (if needed)					
d. Digitize					
e. Run SSURGO AML's					
9. Sampling and lab data					
a. Sampling for NSSL					
b. Sampling for University					
c. Sampling for highway dept					
10. QA reviews and field visit assist.					
a. Pre-initial review					
b. Initial review					
c. Progress reviews					
d. Final review					
e. Prelim. correlation					
f. Final correlation					
g. Field assist. visit					
11. General soil map (STATSGO2) revise and update					
a. Adjust delineation of units					
b. Develop legend					
c. Describe units					
d. Develop diagrams					

Narrative of Plan Items	FY-	FY-	FY-	FY-	FY-
12. Develop survey area soil handbook					
a. Introduction to area					
b. General nature					
c. Crops and pasture					
d. Forestland & windbreaks					
e. Range					
f. Engineering					
g. Recreation					
h. Wildlife					
i. Factors of soil formation					
j. Classification of soils					
13. Interpretation tables					
a. Prepare and update data elements					
b. Generate tables for review					
c. Review tables with technical specialists					
14. Take manuscript photos					
a. Select sites					
b. Review photos with editors					
c. Select final photos					
15. Prepare soil survey manuscript					
a. Select from survey area soil handbook or generate from NASIS					
b. Obtain technical review					
c. Obtain English edit					

Exhibit 608-2 Annual Plan of Operations for Initial Soil Surveys and for Update Soil Surveys Requiring Extensive Revision.

United States Department of Agriculture - Natural Resources Conservation Service

________________ County, ____________________________

Date ______________ Project staff ________________________

Narrative of Plan Items	Responsibility of	Number amount	Hours Per Quarter 1	2	3	4	FY Total
Section A: Long-range Plan of Operation							
1. Memo of understanding (optional)							
a. Meet with locals							
b. Review specifications							
c.							
d.							
2. Collect references							
a. Geology reports							
b. Flood data							
c. Local history							
d. County road maps							
e. Land use							
f. Water quality info							
3. Prepare field sheets (if used)							
a. Edging							
b. Identification							
c. Advance copy identification							
d. Designate acreage							
4. Preliminary field studies							
a. Develop landforms map							
b. Draft initial STATSGO2 update							
c. Test map areas							
5. Descriptive legend (complete data in NASIS)							
a. Prepare taxonomic unit descriptions							
b. Prepare map unit descriptions							

	Respon-sibility of	Number amount	Hours Per Quarter 1	2	3	4	FY Total
6. Documentation and supporting data							
a. Record transects							
b. Yield data							
c. Forest transects							
d. Describe pedons							
e. Analyze transect data							
7. Field mapping							
a. Acreage goal by individual							
8. Field reviews							
a. Pre-initial review							
b. Progress review							
Section B: Soil Management and Interpretations Support Services							
a. Onsite investigations							
b. FOTG							
c. Special evaluation							
Section C: Information Activities							
a. Talk to service club							
b. Prepare news article							
c. Report to cooperators							
Section D: Leave and Holiday							
a. Annual leave							
b. Sick leave							
c. Holidays							

Exhibit 608-3 Workload Analysis – Long Range Plan for a MLRA Soil Survey

WORKLOAD ANALYSIS – LONG-RANGE PLAN FOR THE MLRA-00 SOIL SURVEY AREA

JANUARY 1998

Introduction: The workload analysis for the MLRA-00 contains information regarding the status of soil data at the initiation of the project. It also contains specific action items and completion their dates. The action items are designed to direct the work needed to raise all soils information for the area to current NCSS standards and to update the information at the current standards after the project.

As new information is gathered, the workload analysis will be reviewed and possibly revised. Accordingly, it will be reviewed by the MLRA Soil Survey Office (SSO) technical advisory group biannually beginning in 2000 to consider any appropriate adjustments.

The companion to this document is the memorandum of understanding (MOU) for the overall MLRA Region. It contains cooperating agency agreements that are in place. It also contains specifications that pertain to products produced.

Description of the Work Area: MLRA -00 is about 8.1 million acres and includes all or parts of 33 counties in Alpha, Beta, and Gamma states; of which 17 are in Beta, 15 are in Alpha, and 1 county is in Gamma. The existing MLRA boundary may be altered slightly during the project if a revision is warranted.

Nearly nine-tenths of the MLRA is farmland. About two-thirds of this land is cropland. Corn, soybeans, winter wheat, and hay are the major crops, but sugar beets and canning crops also are important. Some fruit and truck crops are grown in areas of coarser textured soils. Livestock operations are an important enterprise, but they are limited in number and typically are large confinement operations. About one-third of the farmland is used for permanent pasture or for other purposes, such as small farm woodlots. About one tenth of the MLRA is urban land, the largest concentration of which is in the Metro area, that has a population of over 1 million people. Almost all of the area is privately owned.

Elevation ranges from about 175 to 220 meters and gradually increases inland from the lake shore. Local relief on this nearly level, broad lake plain is typically less than 3 meters, but some beach ridges and low moraines rise 4.5 to 9 meters above the general level. The average annual precipitation ranges from 686 to 914 mm. The average annual air temperature ranges from 7.2 to 11.1 C.

The dominant soils are very deep, somewhat poorly to very poorly drained, and fine textured. Some well drained, coarse textured soils are on beach ridges. The dominant soils formed in lacustrine sediments, eolian deposits, and glacial drift on lake plains, beach ridges, outwash plains, and deltas.

Purpose for Doing the Work: The purpose of this project is to coordinate and update soil surveys in MLRA-00 in accordance with current National Cooperative Soil Survey (NCSS) standards.

County soil surveys were published from 1961 to 1987, for except Sigma County, Beta State, which is scheduled for publication in 1994. About half of the soil surveys were published before 1975. About two thirds of the surveys are at a map scale of 1:15,840, and the remainder is at a scale of 1:20,000. The information provided in the reports reflects the knowledge of soil properties and soil behavior relative to the interpretation needs at the time of the field mapping.

The published reports remain an excellent source of data. However, most surveys do not meet current NCSS standards or user needs since new information about soils is needed due to changes in demographics, technologies, environmental questions, and intensities of land use. Existing soil surveys will be built upon, and a database will be developed to address local, regional, and national concerns. The database will provide more comprehensive soil and site data for managing cropland and forest land, conserving water and protecting water quality, improving and maintaining pasture, developing wildlife habitat, developing soil potential ratings, and preparing plans for watersheds and recreational and urban areas.

Status: Work has been done on evaluating existing surveys, reviewing laboratory data, compiling individual county legends into an MLRA legend, formulating modernization plans, and soliciting local cost share funds.

A MLRA SSO technical advisory group was formed in November 1997 to direct and manage the priorities of the MLRA soil survey area. The members of the group include the MLRA Regional Office Leader the State Soils Scientists from Alpha, Beta, and Gamma states, and a representative of the Beta State Soil Survey Agency.

Approach: Initial work will be directed toward legend development, investigations, and data gathering to build on work already done in the evaluation process. It will include assessments of user needs, geomorphology investigations, and evaluations of existing information from the current soil surveys, previous special projects, geological mapping, water table studies, existing soil characterization data, various air photos, and any other pertinent information. A strong emphasis is to be placed on working with all users of the soil survey to assure that the modernization addresses users' needs. Early fieldwork will transect existing map units and sample soils. Recorrelation, map revision, remapping, and map compilation activities will begin later in the project when the legend development is more complete.

Project plans will be developed to address a specific problem or work on a group of soils across the entire MLRA. For example, in several counties in Beta and Alpha States, the major flood plains were mapped as alluvial land (coarse, medium, and moderately fine textured in Beta). A specific task will be to remap these areas and to recorrelate them with the soil series of the map unit name. Enough investigation across the MLRA will be done to assure that the legend design and correlations are valid throughout the MLRA. Work done in recent surveys will be used as a starting point in legend development.

Subset Project Plans will be developed to address the following specific tasks:

1. Flood plain soils
2. Beach ridge soils
3. Till areas (outliers) within MLRA-00
4. Frigid soils correlated in this MLRA prior to soil taxonomy
5. Hydric and nonhydric soils that are mapped and correlated in complexes
6. Soils that developed over bedrock
7. Broad areas of soils that have glacial till underlying lacustrine sediments at depths of 40 to 60 inches and 60 to 80 inches
8. The relationship of prime farmland to areas not prime farmland

Working on specific landforms and parent materials at the same time, will assure accurate and consistent correlations in the most efficient way possible. Sufficient work will be done on all major landform types early in the project to assure the proper development of the legend.

Investigative work in the first year or two of the MLRA soil survey project will be the key to establishing a sound, stable legend that can be used.

A. Data Collection

Data gathering and sampling will be started early in the survey in all parts of the MLRA to assure that results are ready as needed.

1. Retrieval of Archived Data
The MLRA SSO technical advisory group will ensure that the archived information is retrieved and supplied to staff. Information will include available field notes, original field sheets, correlation decisions notes, lab data, and geology reports.

2. Evaluation of Current Data and Information

a. The MLRA SSO technical advisory group will assign an ad hoc "lab data committee" to oversee the indexing and analysis of existing laboratory data.

b. All lab data will be updated on NRCS-SOIL-8(s) - Index of Laboratory Data. The lab data committee will classify the assembled lab data and pedons. Latitude and longitude coordinates will be provided where possible. These coordinates will allow the spatial referencing of pedons for an evaluation of data voids. The expected date of completion is March 2000.

c. The laboratory data committee will work with the National Soil Survey Laboratory (NSSL) to develop a system to incorporate existing lab data into the laboratory database and identify a system that will allow the effective use and analysis of existing and future lab data at the field level. This system should be compatible with NASIS data format, data dictionary, and methods of retrieval. ______________ and ______________ are the contacts in the NSSL. The expected date of completion is December 2000.

d. An ad hoc committee will prepare a "landform/soil classification and characteristics genetic key." The genetic key will be used to identify soils that require specific investigation. This key will also be extremely useful in familiarizing all soil scientists and users of the soil survey information with the soils and the specific landforms on which they occur. The key will provide the necessary details to guide the soil scientist in differentiating soil series. The expected date of completion is June 1999.

e. An ad hoc committee will evaluate the soil series in the project area. All series and their records will be evaluated and updated early in the project. Lab data will be used to update the range in characteristics of the series to provide quantified statements. The differentiating criteria among competing series will be evaluated. Where separations with other series are not clear, plans will be made to study the series more closely. Where differences cannot be identified and substantiated, series will be combined. Suites of soils will be studied by major landform, as grouped in item d. The expected date of completion is December 1999.

3. Detailed Sampling Plan

The information gathered from the evaluation of current data and information will determine where emphasis is needed for detailed sampling and investigations. Data on particle size for most of the dominant or benchmark soils are extensive; other characterization data, however, are limited. Samples will be taken to a depth of 80 inches (2 meters) or to bedrock if it occurs within that depth. The expected date of completion is June 2000.

4. Documentation

All NCSS standards for documentation are to be met. Every effort will be made to utilize existing pedon descriptions, laboratory data, transect information, and all other previously collected information to meet documentation requirements and thereby minimize the amount of new data required and maximize the efficiency of data collection efforts.

5. Special Studies

a. Soil moisture--Since the NC-109 water table study did not include MLRA-00, a regional study will be initiated and coordinated by the university experiment stations to study the relationship between redoximorphic features, water table depths, and duration of wetness. Long-term monitoring sites will be established in areas that are determined to be representative. An interagency committee will be assigned by the chair of the steering committee to develop a plan and provide the necessary guidance. The expected date of completion of the plan is December 1999.

b. Crop yield and forest land inventory--Additional data are needed. Current data will be evaluated, and data voids will be determined. Interdisciplinary ad hoc committees will be assigned the responsibility of developing an inventory plan. An agronomist and a forest land specialist will have the leadership role in the ad hoc committees. The expected date of completion of the plan is December 1999.

c. Soil temperature--Soil temperature will be monitored in locations that relate to forestland and hydric soils and to separate mesic and frigid temperature regimes. Soil temperature will be monitored at 20 inches below the soil surface at weekly or monthly intervals. An ad hoc committee will develop a plan for carrying out all phases of the study. Sites will be established in areas that are determined to be representative. The expected date of completion of the plan is June 1999.

d. Additional studies that are necessitated by questions identified during field investigations will be organized as early as possible. An ad hoc committee will be assigned to develop individual plans to assure comprehensive study throughout the area in question. Plans for special studies will be sent to the MLRA office to be distributed within the state for review and comment.

B. Classification

1. Numerous variants and subsoil or substratum phases of series were correlated in the initial soil surveys. Many of these will be correlated to existing series that have been established in recent years. Some new series will need to be established. All laboratory sampling will extend to a depth of 80 inches or more. Several series will be proposed for current substratum phases.

2. Pedon PC will be used for all descriptions taken in the project.

3. Current laboratory data indicates that some existing series may need to be reclassified. During the evaluation of existing data, these series will be identified and any additional sampling needs will be incorporated into the sampling plan. Based on the analysis of existing and new laboratory data, series will reclassified if appropriate. All pedons will be classified according to Soil Taxonomy, 2nd Edition and the latest amendment. The expected date of completion is December 2002.

C. Legend Development

A list of map units from within the MLRA will be developed using existing information. An ad hoc committee will begin work on this effort in 1999. In addition to an initial list of map unit names, consideration should be given to the coordination of soil symbols, whether alpha or numeric, and to the coordination of features and symbols.

D. Field Reviews

The MLRA soil survey office leader will conduct periodic quality control reviews of the work performed and document the results. The assigned MLRA regional office Data Quality Specialist will conduct periodic quality assurance reviews The MLRA technical advisory group and other cooperators will be kept abreast of all field review activities and will have the option of attending all field reviews.

E. Remapping

During soil survey evaluations for ongoing modernization, a significant variability was identified in soil material between depths of 60 and 80 inches in the soils that were correlated when observations were at a depth of 60 inches or less. Based on these evaluations and subsequent county soil survey evaluations, an estimated 1,075,000 acres, (13 percent of the MLRA) will need to be remapped. Much of the remapping will be relatively minor, such as subdividing existing delineations into two or more delineations or changing some line placement. The evaluations identify specific problems and generally identify where on the landscape to expect them. In some map units, individual delineations may not change, but delineations on different landform positions will be correlated to different map units. Some remapping will be needed to correct joining problems between existing surveys.

F. Recorrelation

Based on the county evaluation worksheets, an estimated 2,015,000 acres (25 percent of the MLRA) will only need to be recorrelated. Many of these areas, which were mapped prior to soil taxonomy, can be correlated to new series that are based on recent work done in adjacent counties. New series will need to be established to correlate some of these map units.

G. Publication Development
One comprehensive database of information will be developed. Subsets of these data may be published for a county or other area if requested by cooperators. Mapping and publication will be at a scale of 1:12,000. Some differences are anticipated in the application of terminology from state to state, such as runoff, drainage class, and productivity indices. The MLRA SSO technical advisory group will develop the guidelines for the use of terminology in publications. The expected date of completion is June 2000.

H. NASIS Soil Database Development
The soil attribute database will be developed and maintained using the National Soil Information System (NASIS) software. It will be used in guiding the planning for field investigations and in testing interpretations.

I. Interpretations
Data from research studies will be used to develop new interpretations, especially water quality interpretations and interpretations for local needs. Special emphasis will be placed on coordinating interpretations between similar soils and between soils that are associated on a given landscape. An ad hoc committee will be assigned by the MLRA SSO technical advisory group to investigate and resolve differences in interpretations regarding items such as capability classification, drainage classification, permeability, soil erodibility, soil loss tolerance, and other factors. Coordinating and sharing data map units in the NASIS and agreement on common interpretative criteria will eliminate these differences. The anticipated date of completion is December 2001.

J. Coordination
Soil classification, correlation, interpretations, and mapping concerns that are identified during fieldwork will be brought to the attention of the MLRA SSO technical advisory group.

Potential Special Research Projects: This project will take a new approach to soil surveying, and many new technologies and methodologies will be used or tested during the project. The following paragraphs discuss potential special projects. The agricultural experiment stations and the Natural Resources Conservation Service will take the lead in these projects. Assistance will be obtained from the National Soil Survey Center and the National Cartography and Geospatial Center. In many cases, some research has already been done and the project should try to put the research to practical use, where economically feasible. The development of special projects will be dependent to some extent on the availability of funds from local, state, and federal sources.

List of Potential Special Projects: Soil-landscape studies of certain major landforms--Mapping consistency can be improved by understanding the soil-landscape relationships and the soil genesis related to landforms of regional importance. Studies should include geomorphological investigations and a consideration of the soil continuum to a depth of 10 to 20 feet. These investigations can provide valuable information for making interpretations related to water quality.

Exhibit 608-4 Project Plan of Operations for an MLRA Soil Survey.

United States Department of Agriculture - Natural Resources Conservation Service

__________ MLRA SSA, __________

Date __________ Project staff __________

Description of priority item to be accomplished: (*e.g. "Coordinate and join all soils mapped on Big Blue River floodplain and the associated stream terraces."*)

Narrative of Plan Items	FY-	FY-	FY-	FY-	FY-
1. Collect references					
a. Geology					
b. Water resources					
c. Statistical reports					
1. Farm					
2. NRI					
3. SWCD					
4. Climate					
5. soil survey evaluations					
6. Other					
d. County roads					
e. Soil maps and data					
f. DEM's					
g. Other Spatial data					
1. Climate					
2. Public Land Survey					
3. etc.					
2. Prepare digital data					
3. Preliminary field studies					
a. Area reconnaissance					
b. Develop landform map					
c. Develop sampling scheme					
d. Test methodology					
e. Correlate studies and field observations					
4. Prepare legend					
a. OSED's.					
b. Map unit desc.					
c. Features and Symbols legend					
d. Identification legend					
e. Classification of soils					

	FY-	FY-	FY-	FY-	FY-
5. Documentation and supporting data					
a. Transect studies					
b. Field notes					
c. Identify problem areas					
d. Field descriptions					
e. Pedon program					
f. Transect program					
g. Soil mapping procedures					
relationships, soil surveyor's model					
h. Other					
6. Sampling and lab data					
a. Sampling for NSSL					
b. Sampling for University					
c. Sampling for highway dept					
7. QA reviews and field assistance visits					
a. Project planning review					
b. Progress reviews					
c. Completion review					
d. Field assistance visit					
8. STATSGO2 revise and update					
a. Adjust delineation of units					
b. Revise legend					
c. Describe units					
9. Take project photos					
a. Select sites					
b. Review photos with editors					
c. Select final photos					

Exhibit 608-5 Annual Plan of Operations for a MLRA Soil Survey.

United States Department of Agriculture - Natural Resources Conservation Service

________________ MLRA SSA, ________________________

Date ________________ Project staff ________________________

Narrative of Plan Items	Responsibility of	Number amount	Hours Per Quarter 1	2	3	4	FY Total
Section A: Long-range Plan of Operation							
1. Collect and analyze references							
a. Geology reports							
b. Flood data							
c. Local history							
d. County road maps							
e. Land use							
f. Water quality info							
2. Prepare digital data							
3. Field studies							
a. Develop landforms map							
b. Draft initial STATSGO2 update							
4. Project area legend							
a. Revise and circulate OSEDs							
b. Review map unit descriptions							

	Responsibility of	Number amount	Hours Per Quarter 1	2	3	4	FY Total
5. Documentation and supporting data							
a. Record transects							
b. Yield data							
c. Forest transects							
d. Describe pedons							
e. Analyze transect data							
6. Project reviews							
a. Field assistance visit							
b. Completion review							
Section B: Soil management and interpretations support services							
a. Onsite investigations							
b. FOTG coordination							
c. Special evaluations							
Section C: Information Activities							
a. Talk to service club							
b. Prepare news article							
c. Report to cooperators							
Section D: Leave and Holiday							
a. Annual leave							
b. Sick leave							
c. Holidays							

Exhibit 608-6 Soil Survey Schedule Guidelines.

SOIL SURVEY SCHEDULE GUIDELINES

This exhibit provides additional guidance for administering the Soil Survey Schedule. It is primarily intended for soil survey program managers and Soil Survey Schedule data stewards. It is divided into major soil survey program business areas for ease of reference. Schedule data elements relevant to the business areas are listed and discussed. Also refer to Exhibit 608-7, a quick reference companion which provides a snapshot of business area responsibilities.

Definitions of data elements are in NASIS, and therefore, are **NOT** repeated in this document. Additional explanations are provided for some data elements.

I. LEGEND ADMINISTRATION and ACREAGE MANAGEMENT

Timely administration of Legends and acreage accountability are critical functions to the schedule's usefulness as a management tool. Legends serve as "place-holders" to project future needs, identify progress, and track milestone events leading to completion of soil survey products for a survey area.

Guiding Principles for Soil Survey Schedule Administration and Maintenance:

1. The Soil Survey Schedule database is imbedded in the NASIS database, and therefore is a multi-user soil survey database. It is the official reporting instrument for production soil survey activities of the National Cooperative Soil Survey.
2. Administration is the responsibility of state offices; updating maps and data is the responsibility of soil survey business area data stewards.
3. Data for Soil Survey Schedule are maintained in legends linked to (Non-MLRA) soil survey areas owned by Pangaea.
4. Schedule can accommodate multiple legends for a survey area. All geographic areas of the Nation are covered in at least one soil survey area, with at least one legend.
5. Data entries may be maintained continuously, but as a minimum, are current at the end of each month. Mapping progress may be reported continuously, but as a minimum, is reported at the end of each quarter.

A. ADMINISTRATIVE Data Elements:

- **Area Name**. This data element applies to both Area Table and Legend Area Overlap Table.
- **Area Symbol**. This data element applies to both Area Table and Legend Area Overlap Table.
- **Area Acres**
- **Soil Survey Area Status**
- **MLRA Office**
- **MOU Agency Responsible**
- **Legend Description**
- **Geographic Applicability**. This data element specifies the currency of soil survey information, including both attribute and spatial data.
- **Legend Certification Status**
- **Export Certification Status**
- **Product Availability Status**

B. ACREAGE MANAGEMENT

Protocols for Acreage Management of (Non-MLRA) Soil Survey Legends:

Seven land categories are used to identify the ownership of all lands of the United States and its Trust Territories. The land categories are: Native American Land, Other Non-federal Land, Bureau of Land Management, U. S. Forest Service, National Park Service, Other Federal Land, and Census Water. Accordingly, acreage is assigned in each non-MLRA soil survey area legend, subject to the following conventions:

1. Land categories reflect current land ownership as it occurs in the survey area.
2. The sum of all land category acres from all legends in a state equals the 1992 NRI acres for the state.
3. Land category acres are balanced across legends that cover the same geographic area, such that each acre is recorded only once.
4. Survey areas that cover parts of two or more states will have a separate legend for each state. One legend will be completely populated with map units and the legend area overlaps for the entire survey area, but will have land category acres, goals, and progress for only one state. Legends for adjacent states will not have map units or legend area overlaps, but will have land category acres, goals, and progress appropriate for that state. Area acres will be for the whole survey area, and will be recorded as the same in each survey area.
5. Acres are recorded to the actual acre, or rounded to 100 acres.
6. Areas in Alaska identified as "Alaska Native Lands", or in Hawaii as "Hawaiian Homelands" are included in the meaning of Native American Land.
7. Census Water applies to all contiguous water polygons that are 40 acres in size or larger. If a water polygon is less than 40 acres in size in the survey area, but extends into an adjoining survey area such that the total extent in both survey areas is more than 40 acres, then the water qualifies as Census Water. Census Water acreage is **NOT** to be part of mapping goals; it is administratively managed in NASIS to account for total survey acres and progress.

Legend Scenarios and Protocols:

1. Survey Areas With One Legend. Only one legend is linked to a (Non-MLRA) soil survey area in NASIS, and no other survey areas have been established that coincide graphically with any part of the survey area. The actual (or best estimate) land category acres are recorded in the Legend Land Category Breakdown table. The sum of all acres recorded in the table are to equal the survey area acreage.
2. Survey Areas With Two or More Legends. These areas typically have an older out-of-date legend and a newer update or published legend. Acres in the Legend Land Category Breakdown table should be re-balanced such that the older legend shows zero acres in each land category. The newer legend should reflect the actual (or best estimate) of land category acres in the Legend Land Category Breakdown table, thus land category acres will be recorded only once in the survey area. Mapping progress should be retained in both the older and newer legend, as appropriate (see section on mapping goals and progress). With the creation of the Soil Data Warehouse, there is no need to copy and paste legends. Surveys areas with two legends can be avoided by managing one legend and prior to Update work, send the legend to the SDW for archive. The SDW will date stamp and version the legend. Managing one legend decreases the burden of managing multiple legends.
3. Survey Areas That Partly Coincide With Another Survey Area. These areas typically consist of an update survey area that covers part of an older survey area, or an update survey that covers two or more previous survey areas. Acres in the Legend Land Category Table should be re-balanced in all affected survey area legends such that current land category acres are recorded in the newest legend and subtracted from older legends. The sum of land category acres in the newest legend will equal the survey area acreage. The resulting sum of land category acres in each of the other affected legends will equal less than their respective survey area acreage. Mapping progress should be retained in both older and newer legends, as appropriate (see section on mapping goals and progress).

II. MAPPING GOALS and PROGRESS

Goals and progress are recorded in the Legend Mapping Goals and Legend Mapping Progress tables for each legend. Goals and progress may be recorded for each individual project member (preferred), or for the project staff as a whole. Use the following protocols:

1. Project Staff. First, enter individual project member names or a name for the entire project staff in the Legend Staff table before entering goals or progress.
2. Goals. Enter fiscal year goals in the Legend Mapping Goals table at the beginning of each fiscal year.
3. Progress. Enter mapping progress and show the effective progress reporting date in the Legend Mapping Progress table under the appropriate land category. **NOTE:** The reporting date determines the fiscal year for progress reporting. Show initial and update mapping under NRCS or cooperator columns, as appropriate. Update acres may be reported in any legend where update activity has occurred.
4. Progress. Once mapping progress has been reported in a legend, that progress should not be moved to another legend, unless an error was made in data entry. However, in order to show the current progress for all land categories, progress may need to be re-allocated among land categories within the same legend to reflect any changes in land ownership. **NOTE:** For situations where land category acres have been re-balanced across legends, acres of mapping progress reported for a land category may be more than the land category acres shown for that legend, and in some cases the land category acres may even be zero.

A. GOAL SETTING

- **Fiscal Year**
- **Staff Member**
- **Staff Member Job Title**
- **Initial NRCS Acres Goal**
- **Initial Cooperator Acres Goal**
- **Update NRCS Acres Goal**
- **Update Cooperator Acres Goal**

B. REPORTING MAPPING PROGRESS

- **Progress Reporting Date**
- **Initial NRCS Acres**
- **Initial Cooperator Acres**
- **Update NRCS Acres**
- **Update Cooperator Acres.**
- **Staff Member**

INITIAL ACRES. This refers to mapping a soil survey area and reporting progress for the first time. The cumulative initial acres reported for a completed survey area always equals 100% of the survey area acres. Applies to all lands of the Nation, and mapping by both NRCS and cooperator personnel. Applies to mapping at any order of detail or scale. Typically, reported only for surveys having a non-project or initial status, but may apply to surveys with update or maintenance status where areas that were not mapped during the initial survey are mapped and reported for the first time. Initial Acres are reported only once for a given geographic area. All subsequent mapping on the same ground is reported as update acres.

UPDATE ACRES. This refers to re-mapping, or updating on parts or all of a survey area and reporting progress on acres previously reported. The cumulative update acres for a survey area may exceed 100% of the survey area acres. Applies to all lands of the Nation, and mapping by both NRCS and cooperator personnel. Applies to mapping at any order of detail or scale. Typically reported for surveys having an update status, but may report for surveys with any status. Applies to reporting progress for surveys in update status including activities that involve systematic transects or field investigations to determine map unit composition, without line changes to polygons (re-mapping).

III. IMAGERY, ORTHOPHOTOGRAPHY and MAP COMPILATION

These data elements are primarily the responsibility of state offices in their administrative and liaison capacity between MLRA regional offices and National Cooperative Soil Survey partners within a state. Field imagery, orthophotography, and map compilation materials may be needed for project survey operations, or SSURGO initiatives.

Acquisition of field imagery, orthophotography, and map compilation materials is coordinated with the National Cartography and Geospatial Center. Development of new imagery and orthophotography, along with related funding and cost-share issues, is coordinated with the National Office. The primary source of new orthophotography development is through the National Agricultural Imagery Program (NAIP).

A. FIELD MAPPING IMAGERY

- **Field Imagery Needed**
- **Field Imagery Ordered**
- **Field Imagery Received**

B. ORTHOPHOTOGRAPHY

- **DOQs Needed**
- **DOQs Ordered**
- **DOQs Received**

C. MAP COMPILATION

- **Compilation Materials Needed**
- **Compilation Materials Ordered**
- **Compilation Materials Received**

IV. INITIAL and UPDATE SURVEY OPERATIONS

These data elements relate most directly to production soil survey operations, and therefore, are the responsibility of MLRA Regional offices. Data elements relative to the memorandum of understanding for project areas and product types are jointly shared by state offices and MLRA regional offices.

A. ADMINISTRATIVE and FIELD ACTIVITIES

- **MOU Signed**
- **MOU Projected Completion**
- **Project Scale**. Standard National map scales are 1:12,000 in quarter quad format or 1:24,000 in full quad format. Puerto Rico is approved for 1: 20,000 and Alaska is approved for 1: 25,000; any other scale and/or format must be approved by the Director, Soil Survey Division, prior to development of the long range plan for the survey area.
- **Initial Field Review Completed**. This date is consistent with the Initial Field Review Report.
- **Final Field Review Completed**. This date is consistent with the Final Field Review Report.
- **Correlation Date**
- **English Edit Site**
- **Digital Map Finishing Site**

B. MAP COMPILATION

- **Compilation Started**
- **Compilation Percent**
- **Compilation Completed**
- **Compilation Certification**

C. MAP FINISHING

- **Map Finish Method.** Choices are digital (preferred) and manual.
- **Map Finish Started**
- **Map Finish Percent**
- **Map Finish Completed**
- **Map Finish to NCGC**
- **Map Finish at NCGC**
- **Maps Sent to Printer**

D. MANUSCRIPT and PRODUCT DEVELOPMENT

1. Manuscript Technical Edit and Review

- **Technical Edit Completed**
- **Technical Review Completed**

2. English Edit

- **English Edit Received**
- **English Edit Started**
- **English Edit Completed**
- **Manuscript Received at NCGC**
- **Manuscript to Printer**

3. Products Data Elements:

- **Product Type.** Six final product types are available from a choice list. All that apply for a survey area are identified according to their publication date. Choices are:
  - Interim Report
  - Soil Attribute/Spatial on CD-ROM
  - Soil Survey Report on CD-ROM
  - Three Ring Bound Manuscript
  - Traditional Bound Manuscript
  - Web Publication
- **Product Description**
- **Scheduled Delivery (date)**
- **Actual Delivery (date)**
- **Availability Status**

V. NATIONAL DIGITIZING INITIATIVE

Background. In FY 1995, the Soil Survey Division began a special funding initiative to digitize high priority soil surveys. The driving force for this initiative was an Executive Order in 1990, whereby the Office of Management and Budget (OMB) established the Federal Geographic Data Committee (FGDC) which promotes the development, coordination, and use of geospatial information on a national basis. Within the FGDC National Spatial Data Infrastructure, the USDA, and specifically the NRCS, has responsibility to develop digitizing standards and to digitize the Nation's soil resources. Digitizing standards and specifications for Soil Survey Geographic Databases (SSURGO) are outlined in part 647.

A 1996 Quality Improvement Team (QIT) sponsored by the Soil Survey Division recommended establishment of digitizing units as part of the national infrastructure needed to complete the digitizing of all soil surveys. In FY 1997, eight digitizing units were established to digitize high priority surveys and to review the digital data and assure that SSURGO certification standards are met. Also, in FY 1997, Congress began providing special funding to accelerate digitizing of all published soil surveys. This funding is part of a national effort to complete digital soils and digital orthophotography for the entire country, and is provided to NRCS as part of the conservation operations budget.

SSURGO Initiatives. Published surveys that were a high priority for field office and USDA service center GIS implementation were the early focus for SSURGO development using the special national allocations. As more of these were completed initial and update surveys with a correlation, and other published surveys became a higher priority and progressive digitizing of on going surveys was consider in funding requests. In FY 2007 with most published soil surveys completed emphasis and funding shifted to initial soil surveys and new digital soil survey mapping techniques. Substitutions for funded surveys may be made at any time, upon request to the Soil Survey Program Manager; the substituted survey should be of similar size and/or value as the original funded survey.

SSURGO Operations. The Soil Survey Division coordinates with NCGC in managing the National Digitizing Initiative. Surveys for special SSURGO Initiative funding are prioritized by states and coordinated for funding. Allocations are based on business area responsibility for SSURGO development; states have responsibility for recompilation of soil survey maps; MLRA Regional offices have soil business responsibility for correlation, for map compilation quality assurance, and for digitizing quality assurance; and digitizing units have responsibility for digitizing and for certification review. The dataset is archived in the Soil Data Warehouse and delivered via the Soil Data Mart, Web Soil Survey and Geospatial Data Gateway. Quality assurance of the SSURGO product is completed at the National Cartography and Geospatial Center.

SSURGO Certification. After SSURGO data has passed a certification review by the digitizing unit, and all paper work and quality assurance is completed by the MLRA Regional office, the survey is certified as meeting SSURGO standards by the responsible MLRA Regional office leader and the state conservationist.

SSURGO Progress Reporting. Progress and status for SSURGO initiatives are tracked continuously in the Soil Survey Schedule. A status map, Status of Soil Survey Digitizing (SSURGO), is produced monthly from progress data in the schedule; refer to part 608.10(d). Business areas with responsibilities for SSURGO development also have responsibility to populate the appropriate data elements in the schedule for survey legends designated as part of the SSURGO initiative; refer to exhibit 608-7, Soil Survey Schedule Business Area Responsibilities. Data stewards are designated to insure timely and accurate progress reporting in the schedule. The schedule data elements specific to the National Digitizing Initiative are identified below:

A. ADMINISTRATIVE

These schedule data elements are the responsibility of the National Office, **ONLY**. Access is through the Soil Survey Schedule web application, or through the conventional NASIS interface.

- **SSURGO Initiative.** This data element must be designated as "yes" in order for digitizing units and NCGC to have legend access for data entry through the Web.
- **Digitizing Unit**. Designation is from a choice list of all the digitizing units. Web access for digitizing units is only through designation of this data element and identification of the survey as a SSURGO initiative.
- **Compilation Funding Year**
- **Digitizing Funding Year**

B. MAP COMPILATION

These schedule data elements for survey legends designated as a SSURGO initiative are the responsibility of the state receiving compilation funds under the special national initiative, or from local sources. Access to the schedule is through the regular NASIS permissions.

- **Compilation Started**
- **Compilation Percent**
- **Compilation Completed**
- **Compilation Certification**

C. DIGITIZING, CERTIFICATION and ARCHIVING

These data elements are the primary responsibility of the digitizing units and the National Cartography and Geospatial Center. If actual digitizing is not done by the designated digitizing unit, states have responsibility to populate digitizing started, digitizing percent, and digitizing completed prior to sending the job to the digitizing unit for certification review.

- **Digitizing Started**. Except for surveys in initial, update or extensive revision status for which progressive digitizing is underway, the correlation document, compilation certification, and attribute data are on file at the office doing the digitizing, or correspondence granting an exception is on file from the MLRA office.
- **Digitizing Percent**.
- **Digitizing Completed**. Quality control work by the state or the digitizing unit, and quality assurance by the MLRA regional office, is normally done after the digitizing is complete, and before the SSURGO review is started.
- **SSURGO Digital Review Started**
- **SSURGO Certification Date**
- **SSURGO Archived**

Exhibit 608-7 Soil Survey Schedule Business Area Responsibilities

NASIS Table Name	Data Element	State Office	MLRA Office	NSSC	NHQ	DU	DMF	NCGC
I. LEGEND ADMINISTRATION and ACREAGE MANAGEMENT								
A. Administration								
area	area_name	X		X				
area	area_symbol	X		X				
area	area_acres	X		X				
legend	soil_survey_area_status	X	X					
legend	mlra_office		X					
legend	mou_agency_responsible	X	X					
legend	legend_description	X	X					
legend	legend_suitability_for_use	X						
legend	legend_certification_status	X						
legend product	product_availability_status	X						
B. Acreage Management								
legend area overlap	area_overlap_acres	X	X					
legend land category breakdown	legend_land_category_acres	X	X					
legend land category breakdown	legend_land_category	X	X					
II. MAPPING GOALS and PROGRESS								
A. Goal Setting								
legend staff	staff_member_name	X	X					
legend staff	staff_member_job_title	X	X					
legend mapping goal	staff_member_name	X	X					
Legend mapping goal	fiscal_year	X	X					
legend mapping goal	initial_nrcs_acres_goal	X	X					
legend mapping goal	initial_cooperator_acres_goal	X	X					
legend mapping goal	update_nrcs_acres_goal	X	X					
legend mapping goal	update_cooperator_acres_goal	X	X					
B. Reporting Mapping Progress								
legend mapping progress	staff_member_name	X	X					
legend mapping progress	progress_reporting_date	X	X					
legend mapping	initial_nrcs_acres	X	X					

NASIS Table Name	Data Element	State Office	MLRA Office	NSSC	NHQ	DU	DMF	NCGC
progress								
legend mapping progress	initial_cooperator_acres	X	X					
legend mapping progress	update_nrcs_acres	X	X					
legend mapping progress	update_cooperator_acres	X	X					
III. IMAGERY, ORTHOPHOTOGRAPHY and MAP COMPILATION								
A. Field Imagery								
legend	field_imagery_needed	X						
legend	field_imagery_ordered							X
legend	field_imagery_received	X						
B. Orthophotograhy								
legend	doqs_needed	X						
legend	doqs_ordered				X			X
legend	doqs_received	X						
C. Compilation Materials								
legend	compilation_materials_needed	X						
legend	compilation_materials_ordered							X
legend	compilation_materials_received	X						
IV. PROJECT and UPDATE SURVEY OPERATIONS								
A. Administrative and Field Activities								
legend	mou_signed	X	X					
legend	mou_projected_completion	X	X					
legend	project_scale	X	X					
legend	initial_field_review_completed		X					
legend	final_field_review_completed		X					
legend	correlation_date		X					
legend	dmf_site			X	X		X	
legend	english_edit_site		X	X	X			
B. Map Compilation								
legend	compilation_started		X					
legend	compilation_percent		X					
legend	compilation_completed		X					
legend	compilation_certification		X					
C. Map Finishing								
legend	map_finish_method		X					
legend	map_finish_started		X				X	
legend	map_finish_percent		X				X	
legend	map_finish_completed		X				X	
legend	map_finish_to_ncgc		X				X	
legend	maps_to_printer							X
D. Manuscript and Product Development								
1. Technical Edit and Review								
legend	technical_edit_completed		X					

NASIS Table Name	Data Element	State Office	MLRA Office	NSSC	NHQ	DU	DMF	NCGC
legend	technical_review_completed		X					
2. English Edit								
legend	english_edit_site		X	X				
legend	english_edit_received		X					
legend	english_edit_started		X					
legend	english_edit_completed		X					
legend	text_received _at_ncgc							X
legend	text_to_printer							X
3. Products								
legend product	product_type	X	X					
legend product	product_description	X	X					
legend product	product_scheduled		X					
legend product	product_delivered	X						X
legend product	product_availability_status	X						
V. NATIONAL DIGITIZING INITIATIVE								
A. Administrative								
legend	ssurgo_initiative				X			
legend	digitizing_unit				X			
legend	compilation_funding_year				X			
legend	digitizing_funding_year				X			
B. Map Compilation								
legend	compilation_started	X						
legend	compilation_percent	X						
legend	compilation_completed	X						
legend	compilation_certification		X					
C. Digitizing, Certification and Archiving								
legend	digitizing_started					X		
legend	digitizing_percent					X		
legend	digitizing_completed					X		
legend	ssurgo_dig_review_started					X		
legend	ssurgo_certification					X		
legend	ssurgo_archived							X

Part 609 - QUALITY CONTROL, QUALITY ASSURANCE, AND SOIL CORRELATION

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Part 609 - QUALITY CONTROL, QUALITY ASSURANCE, AND SOIL CORRELATION

609.00 Definition and Purpose of Quality Control and Quality Assurance.

(a) Soil survey quality control, defined

Soil survey quality control is the collective set of activities described in NCSS standards and procedures whose purpose is to achieve a high level of quality. Controlling quality involves providing direct review and inspection, direction, and coordination of soil survey production activities to ensure that soil survey products meet the defined standards for content, accuracy, and precision. The quality of soil survey products is controlled at the level where each of the soil survey process steps (from field work through publication) takes place. Quality control at the field level is the responsibility of the MLRA soil survey office leader.

(b) Soil survey quality assurance, defined

Soil survey quality assurance is the process of providing technical standards and guidelines, oversight and review, and training to ensure that soil survey products meet National Cooperative Soil Survey standards. Responsibility for assuring the quality of soil survey products such as maps, descriptions, data, texts, photographs, etc., rests with the MLRA regional office.

(c) Purpose

Quality control and quality assurance are important at all levels of the preparation, publication, and update of a soil survey. Their purpose is to ensure that soil survey products are accurate, consistent, meet the objectives outlined in the memorandum of understanding or project plan, and satisfy the needs of the majority of soil survey users. Quality control and/or quality assurance activities are also carried out at other locations where soil survey products are developed such as the National Soil Survey Laboratory, National Cartography and Geospatial Center, etc.

609.01 Policy and Responsibilities for Quality Control and Quality Assurance.

The Natural Resources Conservation Service (NRCS) ensures the quality and integrity of soil surveys through a system of quality control and quality assurance at all levels of activity. The NRCS has the leadership responsibility for nationwide soil correlation within the National Cooperative Soil Survey (NCSS). For soil surveys on federal lands, the NRCS works closely with partner agencies in carrying out these responsibilities.

(a) MLRA Soil Survey Office (SSO), or Soil Survey Project Office for initial (or extensive update) soil surveys.

The MLRA Soil Survey Office Leader is a key decision maker in the NCSS for mapping, data collection, and soil survey product development. Decisions have a broad affect and errors are not easily detected or corrected. The MLRA Soil Survey Office Leader is responsible for:

(1) controlling the quality of all soil survey products developed by that office;
(2) periodically conducting quality control reviews to ensure all products meet NCSS standards;
(3) ensuring that all soil survey products submitted for quality assurance review and certification have passed prior quality control inspections;

(4) making initial correlation decisions for the survey area using NCSS standards and MLRA specific information provided by the MO;
(5) conducting progressive soil correlation during the course of all soil survey activities;
(6) ensuring that all changes to map unit names and legends, and the reasons for the changes, are recorded in NASIS;
(7) ensuring seamless soil survey products across political and physiographic boundaries in the survey area as defined in part 609.03;
(8) assessing training needs of the SSO staff and requesting training from the MO and the State Soil Scientist;
(9) timely preparation of agendas, soil descriptions, lab data, maps, and other information needed for quality assurance reviews conducted by the MO;
(10) ensuring findings and recommendations identified in the MO quality assurance reviews are addressed and implemented in a timely manner;
(11) developing soil survey publications that meet the NCSS standards as outlined in part 644,
(12) developing digital spatial information that meet the NCSS standards as outlined in part 647; and
(13) ensuring that draft or revised Official Soil Series Descriptions (OSDs) meet NCSS standards as outlined in part 614, and have passed the OSD Check Program prior to being submitted for processing.

(b) MLRA Regional Office (MO).

The MO is responsible for:

(1) coordination and quality assurance for all production soil survey and update activities and products, including all data collection, NASIS data population, interpretation, correlation, publications, and digital map development; to ensure that all soil survey products developed in the MLRA Region meet NCSS standards;
(2) making broad regional decisions to determine where to separate soils based on performance, classification, and other factors in order to ensure a seamless and scientifically credible soil survey for the nation;
(3) conducting quality assurance reviews to:
    (i) ensure that products developed by the SSO have passed quality control inspections and meet NCSS standards,
    (ii) ensure that progressive correlation is being implemented and followed by the SSO staff,
    (iii) identify training needs, management and performance issues, and communicate those needs and concerns to the supervisor;
(4) providing states with findings, recommendations and commendations from quality assurance reviews;
(5) providing timely quality assurance review reports and follow-up from other assistance activities to soil survey offices and state offices;
(6) providing (or helping to arrange) training for soil survey office staff in data collection and analysis, mapping techniques, map unit design and naming, soil classification, legend management, NASIS data population, interpretations, soil technologies, quality control procedures, progressive soil correlations concepts and techniques, and overall management of the soil survey;
(7) quality assurance of all attribute data residing in NASIS, and the OSD and Soil Classification (SC) databases;
(8) quality assurance of all OSDs developed or revised in the MLRA Region;
(9) maintenance of the OSD and SC databases;
(10) quality assurance of all spatial data developed in the MLRA Region;

(11) assuring the development of seamless soil survey products across political and physiographic boundaries in the MLRA Region as defined in part 609.03;
(12) developing a blanket memorandum of understanding for the entire MLRA region, that outlines the responsibilities and specifications for conducting soil surveys in the region;
(13) providing MLRA-specific correlation guidelines on soil temperature and moisture regimes and their associated ecological zones and vegetation and any other MLRA-specific information;
(14) providing leadership for the coordinated collection of soil survey related soil characterization data and investigations in the region; and
(15) approving final correlation documents for initial soil surveys.

(c) **State Soil Scientist.**

The state soil scientist is responsible for:

(1) providing administrative and management support and guidance to the soil survey offices that they supervise;
(2) participating in quality assurance review activities sufficiently to support and concur with findings and recommendations,;
(3) providing leadership and working with NCSS partners in identifying the need for new soil survey information and interpretations within the state;
(4) providing digital files for general soil maps, index maps, soil legend and special features legend, geology maps, and block diagrams for use in publications;
(5) submitting complete manuscripts that have passed a State quality control review to the MO; and
(6) ensuring findings and recommendations identified in the MO quality assurance reviews are addressed and implemented in a timely manner.

(d) **State Conservationist.**

The State Conservationist is responsible for:

(1) providing leadership in the conduct of soil surveys in their state;
(2) providing funding support for soil survey offices;
(3) certifying the quality of soil survey products; and
(4) ensuring the findings and recommendations identified in the MO quality assurance reviews are addressed and implemented in a timely manner.

(e) **National Soil Survey Center.**

The National Soil Survey Center is responsible for:

(1) formulation and coordination of national guidelines, procedures, and criteria for producing soil survey information;
(2) quality control of the criteria for classifying soils and of training in soil taxonomy;
(3) quality control of the standards for making soil interpretations;
(4) quality control of standards and criteria and of training for the soils portion of geographic and information systems; and
(5) quality control of analytical procedures used in both laboratory and field investigation of soils.

(f) **National Cartography and Geospatial Center.**

The National Cartography and Geospatial Center is responsible for:

(1) ensuring the cartographic quality of soil survey maps for archiving and distribution;
(2) providing technical guidance specific to cartography and map production;

(3) providing subsets of the Digital General Soil Map of the U.S. and Index to Map Sheets;
(4) coordinating requests for cartographic products;
(5) developing standards, specifications, and providing quality assurance for spatial soil data capture;
(6) providing training in SSURGO quality assurance activities;
(7) assisting MO offices in the quality assurance of SSURGO, digital map finishing, and other cartographic soil survey products; and
(8) providing geospatial web map services (WMS), image map services (IMS), feature map services (FMS), and the Geospatial Gateway for soil survey data distribution and application.

609.02 Soil Correlation.

The NRCS has the leadership for soil correlation within the NCSS. Each MO assures quality of soil surveys through a formal process of soil correlation within each major land resource area (MLRA). For soil surveys on federal lands, the NRCS works closely with partner agencies in carrying out these responsibilities. Soil correlation ensures consistent and accurate mapping, naming, classification, joining, database population, and interpretation within the MLRA. Soil correlation requires that data entered into the soil survey database meets national standards. Soil correlation ensures that all adjacent soil survey maps sharing the same purpose, scale, and order of survey exactly join. Soil correlation requires that soil properties are populated using standard criteria in part 618 that each map unit is distinguished from all others, and that proper interpretations are assigned to each map unit component. Correlation facilitates the effective transfer of technology.

(a) Progressive soil correlation.

Progressive soil correlation is a process that identifies and records all the issues and decisions surrounding soil map unit level information throughout the course of a soil survey. Progressive soil correlation is used in initial soil surveys and update soil surveys requiring extensive revision as well as in MLRA soil surveys. It is practiced throughout the course of a soil survey, keeping pace with progress. Field reviews and field assistance visits are vehicles through which the SSO and the MO promote progressive correlation, maintain quality control and quality assurance, and ensure that technical standards are met. Progressive correlation requires that, during each review or field assistance visit, any changes, deletions, or additions to taxonomic units and map units recognized since the last review or assist are evaluated and, if appropriate, certified. For soils that extend beyond the boundary defining the project area, data and descriptions representing the soil on similar landforms and parent materials are considered in defining ranges for soil properties and determining map unit composition and contribute to the documentation of the survey in progress. All soil survey activities, including interpretation, legend development, joining, soil investigation, and report development, are concurrent with mapping.

(b) Recording progressive soil correlation decisions.

All progressive soil correlation decisions and their reasoning are recorded in NASIS. Any changes or additions to legends, taxonomic units, or map units must be recorded. Significant changes to soil property data and interpretive data, such as ecological site designation, farmland classification, land capability classification, or crop yields, should also be recorded. The reasons for the decision should be recorded if it is relevant and important to future users of the information.

(c) Final correlation.

(1) Final correlation is a process that is used when an initial soil survey is near completion. If, during the course of an initial soil survey, effective progressive soil correlation has taken place, the final correlation is primarily a review of the progressive soil correlation decisions that have been previously made. The final correlation serves as a data check and also identifies any incomplete work that needs to be completed prior to the soil survey being certified.
(2) After the final field review the SSO and the MO schedule a time for a final correlation conference, the outcome of which is the draft correlation document. Although the final correlation is a joint effort between the SSO and the MO, it is the responsibility of the SSO to ensure that all data to be reviewed has passed prior quality control inspections. The SSO is also responsible for gathering and preparing all materials needed for the final correlation.
(3) Items to be reviewed and completed at the final correlation include:
    (i) Review and confirm the classification of each pedon that has been analyzed in a soil survey laboratory or engineering laboratory and revise the classification, as needed. If needed, update NRCS-SOI-8 input form for the index of soil laboratory data for all pedons sampled in the survey area.
    (ii) Review taxadjuncts and taxons needing a correlation note, and record the reason for the taxadjunct or correlation note in NASIS. Record unique or unusual information about a taxon that may prove useful to future users of the information.
    (iii) Review and confirm taxonomic units and their classification. Summarize and process final edits and changes to taxonomic unit descriptions.
    (iv) Review and confirm series validity and their classification. Summarize and process final edits and changes to official soil series descriptions.
    (v) Review and confirm map unit names and ensure their conformity with current naming convention and consistency in the survey area. Summarize and process final edits and changes to map unit descriptions.
    (vi) Review NASIS database entries for accuracy, completeness, and consistency.
    (vii) Review interpretations for accuracy and consistency.
    (viii) Review draft report and identify any needed edits or changes.
    (ix) Review and examine maps for joins, proper labeling, and line conformity with the landform imagery.
    (x) Prepare a join statement that documents where and why map units do not join across survey boundaries. Identify how, where, and when field maps will be compiled, digitized, and map finished.
    (xi) Prepare and review other supporting documents or information to be included in the correlation document. This may include items such as soil-vegetation-climate schema or models, special investigative studies, and lists of references used throughout the course of the survey.
    (xii) Record where all field documentation, field maps, and other supporting materials and information will be archived.
    (xiii) Prepare a draft correlation document. The MLRA Regional Office Leader is responsible for approving the final correlation.

(d) Correlation document.

A correlation document, also sometimes referred to as a correlation memorandum, is a hard copy product that is developed and distributed after the completion of an initial soil survey.

Exhibit 609-1 describes the format of a correlation document. It includes items such as:

(1) Heading
(2) Introductory Paragraph
(3) Headnote for Detailed Soil Survey Legend

(4) Series Established, Dropped, or Made Inactive with the Correlation
(5) Conversion Legend Showing Field and Publication Names and Symbols
(6) Map Unit Legend Sorted Alphabetically
(7) General Soil Map Unit Legend
(8) Feature and Symbol Legend
(9) Cooperator's Names and Credits
(10) Prior Soil Survey Publications
(11) Instructions for Map Compilation, Digitizing, and Finishing
(12) Join Statement
(13) Classification of Pedons Sampled for Laboratory Analysis
(14) Sampled Pedons in Published Soil Survey Report
(15) Notes to Accompany the Classification and Correlation of the Soils in the Survey Area
(16) Classification of the Soils
(17) Miscellaneous Items
(18) Certifications
(19) Signatures

(e) Development, distribution, and amendment policy for the correlation document.

All changes to legends, map units, or taxons for a soil survey area, either initial or update, must be documented and recorded in NASIS. Recording changes to legends, map units, or taxons in NASIS will ensure portions of the correlation document can be generated directly from NASIS.

(1) For initial soil surveys, a correlation document will be produced by the MLRA Regional Office and distributed per the following guidelines:

(i) The state conservationist and the MO Team Leader sign the final correlation document. Their signatures certify that the soil survey is complete and accurate.
(ii) The state conservationist distributes copies of the signed classification and correlation document and of any subsequent amendments to the document as follows:

- One copy to the MO of responsibility for the survey area.
- One copy to each MO that has responsibility for soil series used in the survey area.
- One copy to each state that adjoins the survey area.
- One copy to Director, National Cartography and Geospatial Center.
- One copy to the Director, National Soil Survey Center.
- One copy to NCSS cooperating agencies as appropriate.
- Distribution to NRCS staff within the issuing state is made at the discretion of the state conservationist.

(iii) The final correlation document is archived in the Legend Correlation table in NASIS.
(iv) Prior to SSURGO certification, the archived final correlation document can be amended and hard copies redistributed for an initial soil survey area. Amendments to the final correlation document receive the same signatures and distribution as the original document.
(v) Once a survey is SSURGO certified, and is deemed to be in update status, the correlation document and amendments are archived in NASIS. Subsequent correlation decisions are recorded in NASIS, but the original correlation document is no longer amended.

(2) For update surveys:

(i) All changes to legends, map units, or taxons must be documented and recorded in NASIS. However, the archived correlation document will not be amended and redistributed each time a change occurs as part of update activities.

(ii) In lieu of amending and redistributing a hard copy of the correlation document, a report will be generated from NASIS that lists and identifies all changes to legends, map units, and taxons. This report can be printed and distributed as the MO or state deems necessary.

(iii) A formal correlation document may be prepared and distributed for an MLRA soil survey, or for a special project, or to satisfy an agreement item with a cooperator.

609.03 Seamless Soil Survey.

The goal of soil survey is a seamless product across political and physiographic boundaries. A seamless product entails an exact join of attribute and spatial data between soil survey areas. In some situations, an exact join may not be possible and an acceptable join is achieved.

(a) Exact Joins.

An *exact join* between soil survey areas occurs when soil polygon lines and features are continuous across and along the common boundary and joined soil polygons share the same basic soil properties and selected soil qualities (Exhibit 609-2). Sharing basic properties and selected qualities includes major and minor component composition, basic property ranges (low, high, rv), as well as layer depths. An exact join should be achieved between two surveys of the same, or nearly the same, vintage, stated purpose, scale, and order of survey.

(b) Acceptable Joins.

It is the responsibility of the MLRA Regional Office when employing the acceptable join to affect the best join possible and to document the need for future improvement to the join as appropriate. Acceptable joins are employed primarily when joining previously correlated surveys that would require field investigations to resolve the join discrepancies.

(1) An acceptable join between soil survey areas occurs when soil polygon lines and features are continuous across and along the common boundary and soil properties and selected soil qualities share the same basic soil properties and selected soil qualities (Exhibit 609-2) for most polygons.

(2) Where map unit components do not match, they fit the concept of similar soils.

(3) Rationale for the non-joined polygons (map units) is to be documented .

(c) Joining Requirements.

(1) When completing a soil survey, map unit delineations along the boundary with each of the adjacent survey areas are to be joined. To achieve this goal, soil landscape features must be identified, mapped, and described consistently across political and physiographic boundaries. Data collection, analysis, and summary must represent these natural landscapes.

(2) In most cases, an exact join should be achieved. An acceptable join may be the best join that can reasonably be achieved at the current time. It is a joint responsibility of the MO and state soil scientist to determine the appropriate join between soil survey areas.

(3) If two soil surveys of different orders of mapping are adjacent, an exact join is in effect since the boundary between soil survey areas also serves as soil map unit boundaries. On hard copy maps, a note is printed parallel to the boundaries that separate the areas of each survey order, such as "Limit of Order 3 Survey". Chapter 2 of the Soil Survey Manual provides more

information. Each soil line in the survey of lower intensity must have a corresponding soil line in the adjacent survey of higher intensity, but the converse is not required.

(4) If an ongoing soil survey borders a survey area that requires extensive revision and is out-of-date and therefore acknowledged as being obsolete, the MO should effect the best join possible using available knowledge and tools, but it is not required to revise any part of the out-of-date survey until such time as an update project is initiated. The joining statement in the correlation document should state the situation.

(5) The MLRA SSO prepares a "Join Statement" document that records all discrepancies from an exact join, and any changes made to enact an exact or acceptable join between map unit polygons. Reasons for these changes should also be included in the join statement. This join statement documentation is included in the final correlation document and in NASIS.

(6) Changes in map unit names, or additions and deletions of map units or delineations to an existing soil survey as part of the SSURGO certification process must be documented with an amendment to the final correlation document. Part 609.02 (e) provides information on amending the final correlation document.

(7) When two previously correlated surveys are prepared for SSURGO, there is usually no project office staff available to investigate join discrepancies in the field. To expedite SSURGO preparation, compilers may have to adjust lines and associated data as is practical from the office to affect the best possible join. This generally involves moving lines slightly to conform with new imagery and to come together at the same point along the survey boundary, and coordinating the boundary between the two surveys. Changes in map unit names, or additions and deletions of map units or delineations must be documented with a correlation amendment. Digital soil surveys and discrepancy documentation and statements recorded in NASIS are tools for future update activities to implement MLRA legends and exact joins.

609.04 Quality Control Reviews.

Each individual involved in soil survey operations; whether it is mapping and describing soils in the field, on-screen digitizing of soil boundaries, sampling and classifying pedons, analyzing and summarizing data, populating databases, developing report materials, or any other soil survey activity; has the greatest influence on the quality of the work they perform. All are expected to perform their duties in a way that results in soil survey products that meet NCSS standards and are of a high quality.

The MLRA Soil Survey Project Leader is the first level manager who is responsible to see that all work performed within their assigned area is of high quality and meets NCSS standards. Much of this quality control responsibility is carried out on a day-to-day basis through direct interaction with subordinate staff members to schedule activities and make work assignments, review completed work, provide on the job training, and other related activities. In addition to these routine management activities, systematic reviews are periodically conducted to document the success of the quality control procedures used. The specific details of the items to be reviewed will vary with the kind of activities being carried out as described in the project plan of operations.

Exhibit 609-10 is an example of a Quality Control Review template for an initial soil survey. MLRA Regional Offices are encouraged to adapt this or develop a new one to reflect the activities to be reviewed in a particular MLRA Soil Survey Office. The kinds of activities reviewed may include items such as:

(a) administrative and scheduling
(b) progress reporting
(c) review of mapping
(d) legend development and progressive correlation

(e) adequacy of field documentation
(f) field investigations and sampling
(g) database development
(h) digital map development
(i) publication development

The template (exhibit 609-10) provides separate sections for various soil survey process steps and a set of specific items to be reviewed and certified for each. MLRA Regional Offices should work with the soil survey offices in their region to implement a quality control review process appropriate to their needs.

609.05 Quality Assurance Reviews.

Quality assurance reviews are scheduled on a regular frequency to ensure that technical standards of the National Cooperative Soil Survey are met. In addition, quality assurance reviews can also evaluate and certify that progress is consistent with timelines agreed upon in the work plan. To a lesser degree they can serve to help the soil survey office staff solve problems or provide on-the-job training for the project staff, but these goals are best achieved through separate field assistance visits scheduled for those purposes.

The NRCS General Manual Title 340, Subpart B contains the NRCS policy for and content of other reviews. Access is through the NRCS Electronic Directives System at http://policy.nrcs.usda.gov. The NRCS conducts four types of reviews: Oversight and Evaluation Reviews, State Quality Reviews, State Management Reviews, and Functional Reviews. Each type may include soil survey issues. Exhibit 609-7 lists potential items for these reviews.

(a) Leadership and Participation.

The MLRA Regional Office, or the lead agency for quality assurance, conducts the review. The MLRA Soil Survey Office Leader must be present. Other suggested participants are:

(1) Soil scientists from other nearby areas;
(2) Members of the survey project;
(3) The local district conservationists;
(4) The representatives of cooperating agencies;
(5) The state soil scientist or their designee;
(6) Resource Soil Scientists familiar with the area; and
(7) Discipline specialists such as engineers, geomorphologists, plant scientists, geologists, and others are encouraged to attend as applicable to the agenda for the review.

(b) Kinds of Reviews for Initial Soil Surveys or Update Soil Surveys Requiring Extensive Revision.

Each initial survey or update survey with extensive revision (remapping) requires initial, progress, and final field reviews. Each of these surveys requires one initial field review and one final field review. Most require a yearly progress review. MLRA soil survey projects are reviewed for the status of progress toward meeting the goals and objectives set out in the long range and annual plans of operation. The field review report is a record of items such as the current status of the fieldwork, of observations and decisions, digital map and database development, and of recommended actions. This working document guides future operations and certifies that completed work meets NCSS standards.

(1) Initial field reviews.

The purpose of the initial field review is to guide the soil survey project at the start of mapping, to review the collection and recording of soil data, and to complete preparation of the first formal draft of the descriptive legend, based on the mapping completed and data collected. Exhibit 609-3 lists important items to check before and during the initial field review.

(i) Preparation for an initial field review. An approved soil survey memorandum of understanding must be available for the initial review. (The MLRA Region-wide MOU satisfies this requirement, but an MOU specifically for this project can be developed.) The long range plan of operations must be available. The project office assembles, reviews, and summarizes existing information about the major land resource area and the subset survey area. The staff is in place and has worked in the area long enough to become familiar with the project area and the surrounding surveys. The project office staff prepares:

- preliminary concepts of the major soil-landscape models within the context of the larger MLRA region;
- test mapping of sample areas for the provisional legend;
- notes that support tentative judgments about the range of important soil properties within the most important kinds of mappable soil areas;
- information on the kind and amount of mapping components;
- information on geomorphology, surface features, and kinds of vegetation that provide clues to the kinds of soil and soil boundaries;
- a test of the initial interpretations;
- a first draft of the descriptive legend;
- preliminary data to support judgments about the kinds and number of map units needed for the project area; and
- the equipment, supplies, and base maps.

(ii) Conduct of the review.

- Initial preparations. The review team appraises all initial preparations to ensure that they are adequate and takes necessary action if they are not.
- Field study. The review team evaluates the draft descriptive legend against mappable bodies of soil in the field and reviews the collected soil data. It checks the accuracy of descriptions and the adequacy of map units for making soil interpretations. It evaluates and comments on the mapping done in sample areas in relation to the adjacent surveys. It checks the joining of soil maps and selected soil properties or qualities within the soil survey area and to adjoining survey areas to coincide with the joining specification in the memorandum of understanding. It makes decisions on soils for which the classification is doubtful.
- Descriptive legend. As a minimum, the descriptive legend consists of the taxonomic and map unit descriptions, the classification of the soils, the general soil map (Digital General Soil Map of the U.S. – STATSGO) and legend, the identification legend, and the feature and symbols legend. After the field study, the team evaluates the draft descriptive legend and makes necessary revisions. The review team examines the naming of the kinds of map units, the classification of the kinds of soil identified in the map units, the general soil map (Digital General Soil Map of the U.S. – STATSGO2) and legend, the list of features and symbols for the soil survey, and the definitions of ad hoc features. The team emphasizes the design and description of map units to meet the objectives of the survey. The descriptive legend includes only the map units and features that are actually identified and described before or during the initial field review.

- Scheduling. The review team discusses and schedules long- and short-range activities that are necessary for completing the survey. Exhibit 609-3 identifies many of the items to check before and during the initial field review. The team discusses activities and schedules:

  (a) preparation of parts of the soil handbook for the survey area,
  (b) plans for soil investigations and collection of samples for laboratory analysis,
  (c) collection of data on yields and soil performance in all land uses,
  (d) recording of field notes, and
  (e) preparation of the soil survey publication.

The review report initiates and includes arrangements for completing laboratory work and schedules subsequent progress field reviews and special studies.

(iii) Preparation of the report. The leader of the initial field review prepares a report of the review. The report includes a "Quality Assurance Worksheet." The MLRA Regional Office leader approves the report. Exhibit 609-8 is an example of a Quality Assurance Worksheet. In addition to the worksheet, the report includes:

- the identification legend;
- a progress map;
- draft descriptions of proposed new soil series;
- a statement on the accuracy of map unit composition and attribute data;
- notes recording important observations made during the field study;
- instructions and items agreed upon for the field soil scientists and others, which concern conduct of the survey and the assignment of responsibilities, priorities, and dates of accomplishment;
- a list of classification of the taxa for the survey area;
- a subset of the Digital General Soil Map of the U.S. (STATSGO) database for the survey area as a general soil map; and
- a letter transmitting the report to the state conservationist and others as appropriate, in which the MLRA Regional Office leader highlights significant issues and items that are agreed upon.

(2) Progress field reviews.

The purpose of this review is to assess progress and assure that NCSS standards are being met. Progress field reviews emphasize progressive correlation in a manner consistent with the larger MLRA soil survey area, and certification of the work completed to date. Help may also be provided to the soil survey project staff on problems of soil classification; field mapping; data collection, storage, and retrieval; and soil interpretation, but these are generally best addressed during a separate field assistance visit.

The frequency of progress reviews depends on the rate of progress, the complexity of the soil survey area, and the experience of the project office. Exhibit 609-4 gives a list of some of the important items to check before and during progress field reviews.

(i) Conduct of the review. The review team spends at least some of the time in the field observing examples of mapping, field descriptions, and associated data and interpretations to assure that the local quality control procedures are effective. They examine maps for correct soil identification, proper placement of boundaries, legibility, and kinds and amounts of components in delineations. They check the maps and databases for the join with adjacent surveys. The team compares findings with statements in the descriptive legend. Where problems are noted, the group concentrates on solutions to assist the staff in avoiding similar future problems.

- The progress field review team reviews the recommendations of the soil survey staff for progressively correlating completed mapping. They make a record of the reason(s) for any correlation decisions and any work needed to update field sheets.
- The review includes a check of all interpretations. The team cross-checks field data, such as forestry productivity, for use. The review recommends changes and additions soil property records.
- The review includes the quality and status of the descriptive legend and the soil handbook of the survey area. The review team recommends revisions for the descriptive legend as necessary to meet the objective of the survey.
- The review team checks the adequacy of field notes and the rate and progress of mapping and other scheduled survey activities.
- The review team determines if action has been taken to correct deficiencies and complete items agreed upon that were noted in previous field reviews.

(ii) Preparation of the report. The leader of the progress field review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA office. Exhibit 609-8 is an example. In addition to the Quality Assurance Worksheet, the report includes:

- a list of commendable activities of the soil scientists assigned to the survey area;
- a list of items agreed upon, who is responsible, and the date for its completion;
- a statement of the accuracy of map unit component and attribute data;
- a progress map;
- an updated list of classification of the taxa in the survey area;
- notes recording important observations made during the field studies;
- a record of additions, deletions, or other changes to the descriptive legend;
- a complete updated identification legend;
- a letter transmitting the report to the state conservationist and others as appropriate, in which the MLRA regional office leader highlights significant issues and items that are agreed upon; and
- an evaluation and comments on the status of scheduled actions from earlier progress reviews.

(2) Final field reviews.

The purpose of the final field review is to evaluate the entire survey to assure that the work is of acceptable quality and to complete necessary modifications before field operations end. The final field review can be held about 1 year before the completion of mapping in initial soil surveys. Exhibit 609-5 provides a list of some of the important items to check before or during the final field review. Most soil survey activities are complete and the collected data is available prior to the final field review. The activities include:.

(i) completing the mapping; checking consistency and quality of mapping throughout the survey area; collecting soil sample and interpretation data for correlation; finishing the complete draft of the soil survey report and database entries; revising the Digital General Soil Map of the U.S. (STATSGO) database and if one is to be prepared, the general soil map; completing laboratory analysis and soil investigations; providing correlated names and classifications for pedons in the laboratory database; taking photographs; and preparing illustrations.

(ii) Conduct of the review. The major portion of the review occurs in the office. Field checks take place if questions occur that can only be answered in the field. Those activities that were noted as needing corrective action during the last progress review receive special attention. Items scrutinized by the review team include the descriptive legend and supporting information; map unit names, composition, and associated data; the joining of the Digital General Soil Map of the U.S. (STATSGO) database; the draft soil survey report; and interpretative tables.

(iii) Preparation of report. The leader of the final field review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Office. Exhibit 609-8 is an example of a Quality Assurance Worksheet. In addition to this worksheet, the report includes:

- an identification legend;
- a feature and symbol legend;
- a progress map;
- a record of soil characterization samples that were collected for laboratory analysis in the survey area;
- a record of soil samples that were collected for engineering tests;
- a statement on the accuracy of map unit component and attribute data;
- an updated list of classification of taxa in the survey area;
- an evaluation of the soil survey report;
- a list of commendable activities of the survey project staff;
- a list of actions agreed upon;
- a record of the decisions made during the review; and
- a preliminary correlation memorandum, as prescribed in part 609.02 of this handbook;
- a letter transmitting the report to the state conservationist, and others as appropriate, in which the MLRA regional office leader highlights significant issues and items that are agreed upon; and
- an evaluation and comments on the status of scheduled actions from any earlier progress reviews.

(iv) Final Soil Survey Field Activities for Initial Soil Survey Projects and for Update Projects Requiring Extensive Revision.

The project office schedules time between the final field review and the final correlation for several tasks. These tasks are to complete the mapping, perform final checks, review the fieldwork and soil survey database, complete the final draft of the soil survey publication, and update all supporting records and data, such as map unit acreage data, map compilation, and statistical analysis for map unit composition information. Preparation of the final correlation memorandum requires completion of these activities. The final correlation memorandum is finalized upon signature by the MLRA regional office leader and state conservationist(s). Part 609.02 discusses preparing and distributing a correlation memorandum, and Exhibit 609-1 discusses the format of the final correlation memorandum.

(c) MLRA Soil Survey Project Quality Assurance Reviews.

(1) MLRA soil survey project progress reviews.

Progress field reviews emphasize evaluation of activities of the field staff to assure that they are carrying out soil survey update activities as described in the project plan of operations for the area, NCSS policy and procedures are followed, and certification that the completed work meets NCSS standards. They may also provide help to the staff on problems such as soil classification; updating of maps; data collection and analysis, storage, and retrieval; and soil interpretation.

The frequency of progress reviews depends on the rate of progress the complexity of the project area, and the kinds of update activities being conducted. Exhibit 609-6 gives a list of some of the important items to check before and during project reviews.

(i) Conduct of the review. Activities are tailored to reflect the nature of the work being performed. Commonly the review team spends part of the time in the field reviewing the collected soil data. They also examine digital maps for correct soil identification, proper placement of boundaries with landforms and imagery, and validity of models used in revising the soil maps. As necessary, the group concentrates on solutions to problems brought to their attention by the field staff or discovered during the review process.

- The review team checks the adequacy of documentation and the rate and progress of scheduled survey activities.
- The review team determines if action has been taken to correct deficiencies and complete items agreed upon that were noted in any previous field reviews.

(ii) Preparation of the report. The leader of the project review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Regional Office. Exhibit 609-9 is an example of a Quality Assurance Worksheet. In addition to the worksheet, the report includes:

- a list of commendable activities of the soil scientists assigned to the survey area;
- a list of items agreed upon, who is responsible, and the date for its completion;
- a statement of the accuracy of map unit component and attribute data;
- an updated list of classification of the taxa in the survey area;
- notes recording important observations made during the field studies;
- a complete updated identification legend for the project area;
- a letter transmitting the report to the state conservationist(s), and others as appropriate, in which the MLRA Regional Office leader highlights significant issues and items that are agreed upon; and
- an evaluation and comments on the status of scheduled actions from any earlier progress reviews.

(2) MLRA soil survey project completion reviews.

The purpose of the project completion review is to evaluate the activities to ensure that the work meets NCCS standards and to complete necessary modifications before individual project operations end. The project completion review is held when activities described in the current plan of operations are nearing completion. Exhibit 609-6 provides a list of some of the important items to check before or during the project review.

(i) Activities completed prior to project completion reviews. The activities include completing the digital revisions, checking consistency and quality of previous mapping evaluated throughout the project area; collecting soil sample and interpretation data for correlation; completing laboratory analysis and soil investigations; and providing correlated names and classification for all applicable pedons in the laboratory database.

(ii) Conduct of the review. The major portion of the review occurs in the office. Field checks generally are covered under field assistance visits (part 609.06) and take place if questions occur that can only be answered in the field. Those activities that were noted as needing corrective action during the any project progress review receive special attention. Items scrutinized by the review team include supporting information, the validity of map units and their names and the tabular database. A check is made to ensure that correlation decisions are recorded in NASIS.

(iii) Preparation of report. The leader of the project completion review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Regional Office. Exhibit 609-9 is an example of a Quality Assurance Worksheet. In addition to this worksheet, the report includes:

- an identification legend of revised map units
- a feature and symbol legend;
- a record of soil characterization samples that were collected for laboratory analysis in the survey area;
- a record of soil samples that were collected for engineering tests;
- a statement on the accuracy of map unit component and attribute data;
- an updated list of classification of taxa in the survey area;
- a list of commendable activities of the survey project staff;
- a record of the decisions made during the review;
- a letter transmitting the report to the state conservationist(s), and others as appropriate, in which the MLRA Regional Office leader highlights significant issues and items that are agreed upon; and
- an evaluation and comments on the status of scheduled actions from any earlier progress reviews.

(d) Signature and Approval of Review Reports.

(1) Review team leader. The MLRA Regional Office or a cooperating agency leads the review and is responsible for preparing and signing all review reports, and transmitting copies of the review report to the state conservationist(s) and others as appropriate. The MLRA Regional Office leader signs the transmittal letter.

(2) Representatives of cooperating agencies. Representatives of cooperating agencies may also sign all review reports, such as the Quality Assurance Worksheet. When other partner agencies (for example, the USFS) lead the review, NRCS participates in a quality assurance role which does not replace the responsibilities assigned to the partner agency. Field review reports and other documentation regarding survey quality on federal land require the signature of either a representative of the agency who participates in the review activity, or a designated representative of the agency, to document agreement or disagreement by signing the report.

(3) State Conservationist. The state conservationist, or appointed designee, reviews and signs the report as a means of documenting the transfer of significant issues and agreed to items pertaining to the review.

(i) Arrangements for managing all review reports by participating cooperators can be described in the memorandum of understanding or the work plan.

(ii) The signed document is a part of the soil survey record file.

(e) Distribution and Review of Review Reports.

The MLRA Regional Office leader distributes copies of all field reviews within 30 days after the final day of the review. The leader sends at least one copy of the field review report and attachments and a letter of transmittal to the:

(1) project office in charge,
(2) state conservationist(s),
(3) state soil scientist,
(4) agencies cooperating in the survey,

(5) MLRA Regional Office, and
(6) others as appropriate.

609.06 Field Assistance Visits.

The MLRA Soil Survey Office, State Office, or a cooperating agency office may request help from the MLRA Regional Office as needed. The MLRA Regional Office may schedule field assistance visits as necessary also.

A written trip report is to be prepared documenting the activities from the field assistance visit and distributed to the participants, as well as the State Soil Scientist and any appropriate cooperating agencies. Decisions that affect the legend, data collection or recording, classification of soils, or interpretations become part of the permanent and formal record of the survey upon inclusion in the final field review or MLRA project completion report.

609.07 Final Soil Survey Field Activities for Initial Soil Survey Projects and Update Projects Requiring Extensive Revision.

The project office schedules time between the final field review and the final correlation for several tasks. These tasks are to complete the mapping, perform final checks, review the fieldwork and soil survey database, complete the final draft of the soil survey report, and update all supporting records and data, such as map unit acreage data, map compilation, and statistical analysis for map unit composition information. Preparation of the final correlation memorandum requires completion of these activities.

(a) Final Correlation Memorandum. The draft of the final correlation memorandum is prepared at the final correlation conference. The final correlation memorandum is finalized upon signature by the MLRA Regional Office leader and State Conservationist(s). Part 609.02 discusses preparing and distributing a correlation memorandum and Exhibit 609-1 discusses the format of the final correlation memorandum.
(b) Final Draft of the General Soil Map (Digital General Soil Map of the U.S.). The project office prepares the general soil map for the final field review on its publication scale base map in final form. This map is from the Digital General Soil Map of the U.Sdatabase. Inclusion of this map in the soil survey publication is optional. Revise the general soil map unit names as needed to agree with the general soil map legend in the correlation memorandum.

609.08 General Soil Maps, Index Maps, and Location Maps

The MLRA office assures the technical quality of general soil maps, index maps, and location maps. The general soil maps are optional in soil survey publications (manuscripts posted to the web or as hard copies), but index maps and location maps are required.

If a general soil map (GSM) is not to be included, cooperators should agree with the decision. Also, an up-to-date Digital General Soil Map of the U.S. (STATSGO) database map of the survey area should be readily available to the public. The availability of the Digital General Soil Map of the U.S. should be noted in the publication. For example, it could be noted in the section "How To Use This Soil Survey."

(a) General soil maps and index maps.

(1) Each soil survey publication includes an Index to Map sheets. The National Cartography and Geospatial Center staff provides an Index to Map Sheets. By request, a soil survey area subset of the Digital General Soil Map is provided by NCGC as one of the map sources for the GSM. The other source for GSM development is SSURGO. NCGC assists in determining format and the number of maps needed. A draft of the general soil map developed from the Digital General Soil Map or SSURGO and associated legend are completed to the extent possible after correlation decisions have been finalized. The Data Quality Specialist reviews the GSM and legend to verify that:

(i) soil map boundaries are accurate;

(ii) GSM map unit names conform to the correlated names on the detailed maps;

(iii) the map legend and manuscript are in agreement;

(iv) the general soil map legend matches adjoining survey areas which ensures that all delineations are closed and symbolized, that the area of each map unit compares with the percentage given for the survey area, and that the organization and levels of generalization of the map and legend are appropriate;

(v) map delineations and legends join the Digital General Soil Map of the U.S. for adjacent surveys; and

(vi) if the percentage of each component in the GSM is given, the total acreage of each is not more than is shown on the acreage table for the detailed map units

Once the draft general soil map is approved, the detailed soil legend and feature and symbol legend can be ordered.

(2) The procedure for ordering is as follows:

(i) Place orders with NCGC on-line at http://www.ftw.nrcs.usda.gov/ncgcos/

(ii) Order the color check print of the general soil map, the index to map sheets, the feature and symbol legend, and the detailed soil legend from the National Cartography and Geospatial Center. List the headnote to accompany the detailed soil legend if it is different from that shown in the final correlation memorandum. If the headnote is different, amend the final correlation memorandum to reflect the change.

(iii) Indicate additional instructions for completing the order as. Include special instructions needed by the cartographic staff to prepare the symbols legend. Show suggestions for the selection of the colors that show soil groupings or levels of generalization on the supplement or on the edited legend. Attach a copy of the final correlation memorandum, including any amendments, the electronic file of the Digital General Soil Map of the U.S., and a copy of the edited general soil map legend to the order.

(3) MLRA Regional Office checking. The National Cartography and Geospatial Center completes the order and sends the Digital General Soil Map generated general soil map color check print, the index to map sheets, and the legends to the MLRA Regional Office for final review and approval. The MO checks:

(i) the GSM legend against the edited copy,

(ii) the detailed soil map legend against the final correlation memorandum and any amendments,

(iii) the names of cooperating agencies on maps and legends against the final correlation memorandum and any amendments,

(iv) the name of survey area on maps and legends against the final correlation memorandum and any amendments, and

(v) the conventional and special symbols legend for agreement with maps and the final correlation memorandum.

The MLRA Regional Office makes needed changes and corrections on the Digital General Soil Map of the U.S. and returns them to the National Cartography and Geospatial Center. The National Cartography and Geospatial Center staff makes the corrections identified.

(b) Location maps.

Each soil survey publication requires a location map. This map shows the location of the survey area in the state. The MLRA Regional Office orders the location map at the time the soil survey manuscript is received for technical review. The National Cartography and Geospatial Center staff prepares the location map.

Exhibit 609-1 Format for Correlation Document.

The following outline shows the order and character of items and data ordinarily contained in a correlation document. It does not preclude the inclusion of other information pertinent to the survey or the explanation of actions taken in the correlation. An example follows each item.

1. Heading.

UNITED STATES DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

Classification and Correlation
of the Soil Survey of
Any Area, Any MLRA, Any State

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (Voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

2. Introductory Paragraph.

In this paragraph cite persons participating in the correlation, the date, the location, data reviewed, the basis for the correlation, and other items if pertinent. For example: "John C. Smith, soil data quality specialist, and David G. White, MLRA soil survey office, of the Natural Resources Conservation Service and Joseph I. Black, associate professor, Anytown State University at Any Town, Any State, prepared this correlation the week of October 21-25, 2000. The soil survey database, soil survey publication, field notes, interpretations, laboratory data, correlation samples, field map sheets, and materials from the adjacent soil surveys provide the basis for this correlation."

3. Headnote for Detailed Soil Survey Legend.

This headnote is an explanation of the symbols on the detailed soil maps in the published survey. It appears on the "SOIL LEGEND" in the published report and precedes the list of map unit symbols and map unit names. For example: "Map unit symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Map unit symbols without a slope letter indicate nearly level soils or miscellaneous areas."

4. Field and Publication Names and Symbols.

The correlation of soil map units is formatted into four columns. List map unit symbols for publication alphabetically or numerically in sequence. The heading and format are as follows:

Field Map Unit Symbol	Field Map Unit Name	Publication Map Unit Symbol	Approved Map Unit Name
DeB	Delta sandy loam, 2 to 6 percent slopes	AbB	Alpha sandy loam, 2 to 6 percent slopes
Bf	Beta mucky silt loam	Be	Beta silt loam

GaB, GhB	Gamma silt loam, 2 to 6 percent slopes	GaB	Gamma silt loam, 2 to 6 percent slopes

5. Series Established by This Correlation.

List the soil series established by this correlation. List in parentheses, after the series name, the county, the parish or survey area, and the state in which the type location occurs if the type location is in a soil survey area other than the one being correlated. For example: "The Alpha series is established by this correlation, the Alpha type location in the adjoining Beta County soil survey area, Any State." Enter "None" if no new series were established.

6. Series Dropped or Made Inactive.

List the soil series that were dropped or made inactive by the correlation. For example: "The Beta series is made inactive by this correlation." Enter "None" if no series were dropped or made inactive.

7. Cooperators' Names and Credits.

List the following:

--The cooperators' names, and
credits to be given in the published soil survey.

The cooperators are:

"United States Department of Agriculture
Natural Resources Conservation Service
In cooperation with
Anystate Agricultural Experiment Station
Anystate Conservation Commission
Anystate Cooperative Extension Service
Any Soil and Water Conservation District"

The credits to be given in the published soil survey are as follows:

"This survey was made for Any Survey Area, Anystate, by the Natural Resources Conservation Service and the Anystate Agricultural Experiment Station, Anystate Conservation Commission, and the Anystate Cooperative Extension Service. It is part of the technical assistance furnished to the Any Survey Area Soil and Water Conservation District. The Any Survey Area Board of Commissioners provided financial assistance for the survey."

8. Prior Soil Survey Publications.

Indicate the reference to prior soil survey publications that will appear in the introduction of the published soil survey. A prior published soil survey is a literature citation in the soil survey publication. For example: "The first soil survey for Any Survey Area, Anystate, was published by the U.S. Department of Agriculture in 1903. Maps were printed in 1905. This soil survey is on an aerial photography base and contains more interpretative information." Enter "None" if there is no prior soil survey publication.

9. Miscellaneous Items.

Use the appropriate headings and include items pertinent to the correlation or publication of the survey. For example, the soil-vegetation-climate schema, or model, used to guide correlation for the survey area should be included. Other examples might include a summary of soil temperature or moisture studies, or special investigative reports that provided guidance for the survey area.

10. Instructions for Map Development.

These brief instructions should include:

- Identifying who is responsible for the development of digital spatial data.
- What is the date and projection of the orthophoto imagery being used for the base map.
- Identifying who is responsible for digitizing the maps and when it is scheduled.
- Identifying who is responsible for finishing the digital maps and when it is scheduled.
- Identify if a layer for point and linear map units will be compiled and digitized.
- Any other instructions that may be relevant to the achieving a digital soils layers.

Detailed instructions for map compilation are found in NSSH part 647.

11. Feature and Symbol Legend.

Include a copy of form NRCS-SOI-37A and indicate the features and symbols that are used in the survey area by highlighting or underlining in red. For example: "Only those symbols indicated on the NRCS-SOI-37A will be shown on the legend." Complete the descriptions for standard landform and miscellaneous surface features and descriptions for ad hoc features on the back of the NRCS-SOI-37A for those features indicated.

12. General Soil Map Unit Legend.

List the general soil map unit that will be shown on the legend of the general soil map of the survey area. For example:

"The following map units will be used on the general soil map legend:

Alpha-Beta to Alpha-Beta association

Beta-Gamma-Zeta to Beta-Gamma-Zeta association."

13. Conversion Legend.

List all field symbols and their approved publication symbols. A conversion legend is not needed if field symbols and publication symbols are identical. For example:

CONVERSION LEGEND, ANY SURVEY AREA, ANYSTATE

Field Symbol	Publication Symbol	Field Symbol	Publication Symbol
7A	7A	20B	20B
7B	7B	21C	21D
7C	7C	21E	21E

14. Legend of Map Units in Alphabetical Sequence.

This legend is used only where numeric symbols will be published to assist publication crosschecking. For example:

LEGEND OF MAP UNITS IN ALPHABETICAL SEQUENCE, ANY SURVEY AREA, ANYSTATE

Publication Symbol	Approved Map Unit Name
43	Alpha clay
37	Beta clay loam, 5 to 9 percent slopes, eroded
39	Beta clay loam, 9 to 14 percent slopes, eroded

15. Classification of Pedons Sampled for Laboratory Analysis.

This table lists pedons that have laboratory data or engineering test data. Give the source of the data and other pertinent information. In the table "Publication Symbols," refer to the map symbol that identifies the area from which the sample was taken. Additional columns can be added if needed.

CLASSIFICATION OF PEDONS SAMPLED FOR LABORATORY ANALYSIS

Sampled as	Soil Survey Sample No.	Publication Symbol	Approved Series Name or Class Identification

1. Laboratory Data from the NSSC Soil Survey Laboratory

Alpha	S79AS-047-003	AbB	Alpha
Beta	S79AS-047-004	GbB	Gamma

2. Laboratory Data from the Anystate Agricultural Experiment Station Laboratory

Beta	S79AS-047-005	BgB	Beta
Gamma	S79AS-047-006	AaA	Alpha

3. Laboratory Data from the Anystate Highway Department Laboratory

Alpha	S79AS-047-007	AaA	Alpha
Beta	S79AS-047-008	BbC	Beta

16. Sampled Pedons in Published Soil Survey Report.

This table lists the pedons and laboratory data that will be included in the published soil survey report. These pedons should represent the typical pedon for the series in the survey area. Where the pedon is not the typical pedon for the series in the survey area, also place a tabular or semi-tabular description in the soil survey report.

Series	Sample No.	Status
Alpha	S79AS-047-003	Typical pedon for the Alpha in the survey area.
Alpha	S79AS-047-011	Typical pedon from map unit Aa.

17. Notes to Accompany the Classification and Correlation of the Soils of Any Major Land Resource Area, Any County, Any State, by A. B. Smith, Soil Correlator.

Any notes of general explanation that contribute to the understanding of the correlation can be included as an introductory paragraph. For example: "This survey area is in a transitional zone of temperature regimes. Soils of mesic and thermic temperature regimes have been correlated."

In the notes, include items such as:

(a) Pertinent information about series being established. For example: "Alpha Series. The Alpha series is established by this correlation for soils that were formerly mapped as Beta but that have mixed mineralogy rather than siliceous mineralogy as defined for Beta."

(b) How taxadjuncts differ from the series concept. For example: "Gamma Taxadjunct. This soil is a taxadjunct to the Gamma series because it contains less than 15 percent sand that is coarser than very fine. The soil classifies as coarse-silty."

(c) A correlation note for soils that are slightly outside the official series range but are not taxadjuncts. For example: "Beta soils in this survey have a redder subsoil and are slightly more acid throughout than those defined in the official series description. These differences do not affect taxonomic placement or use and management. The official series description was not revised because the color and reaction differences are due to the inherent characteristics of the Theta geologic formation in which these soils formed and which is not the typical formation in which the Beta series formed."

18. Classification of the Soils.

This table is the classification of the taxonomic units that are used in the survey area. Classify taxonomic units that are named at a level above the series as precisely as the data permits. Designate taxadjuncts with an asterisk only if the representative pedon is a taxadjunct. Address map units with major components that are taxadjuncts in the "Notes". Do not list miscellaneous area names in the classification table. For example:

CLASSIFICATION OF THE SOILS OF ANY SURVEY AREA, ANYSTATE

Soil Name	Family or Higher Taxonomic Class
Alpha	Coarse-loamy, mixed, active, frigid Aridic Haploxerolls
Beta	Fine-silty, mixed, active, frigid Cumulic Epiaquolls
Gamma*	Coarse-loamy, mixed, active, frigid Dystric Eutrudepts
Udorthents	Udorthents

*Taxadjunct. See "Notes to Accompany Classification and Correlation of the Soils of Any Survey Area, Anystate" for details.

19. Join Statement

The join statement prepared at the final field review is included that explains where an exact join was not achieved. It should identify what map units need to be reviewed and their joins resolved.

20. Certifications.

The correlation document is to contain certification of the following:

(a) Mapping is complete. For example: "Mapping completed in June 1999."

(b) General soil maps and detailed maps are to exactly join with those of adjacent survey areas, and detailed maps join within the survey area. Discrepancies in the join of maps with those of adjacent areas are documented, and a detailed statement of join differences is referenced and included in the correlation document. The reason the maps cannot be joined is given in the join statement.

(c) Databases and interpretations are coordinated and complete. For example: "Databases and interpretations are coordinated, map unit lines of adjoining surveys are continuous across and along the shared borders and the joined map units share basic soil properties and selected soil qualities. All data elements are populated and no obsolete terms are used."

(d) Type locations are in soil areas that have the referenced names, and location descriptions are correct. For example: "The locations of all typical pedons used in this survey are within the major land resource area and are correct and are within delineations that have the referenced name."

(e) Forestland and rangeland site plots were taken in soil areas that have the referenced series names and the series names have been correlated in the forestland and rangeland databases and all data is certified.

(f) All typical pedons are classified according to *Soil Taxonomy, 2nd Edition* and the latest amendment. For example: "All typical pedons are correctly classified according to *Soil Taxonomy, 2nd Edition* and the latest amendment."

(g) Only approved names for miscellaneous areas have been used as component names.

(h) The soil maps have been reviewed for completeness, accuracy, and consistency. For example: "The soil maps are complete, accurate, and consistent."

21. Approval Signature and Date.

______________________ State Conservationist	______________________ Date
______________________ MLRA Regional Office Team Leader	______________________ Date

Exhibit 609-2 List of Soil Property or Quality Attributes for Joining.

The following list provides basic soil properties and selected soil qualities that are to be joined between soil surveys to achieve an "exact" join. National Soil Information System (NASIS) data element names are used for convenience, but their usage is not intended to suggest a database solution.

National Attributes *

Soil Property or Quality Name
aashto_group_classification
aashto_group_index
albedo_dry
aluminum_oxalate
available_water_capacity
bulk_density_fifteen_bar
bulk_density_one_tenth_bar
bulk_density_one_third_bar
bulk_density_oven_dry
calcium_carbonate_equivalent
cation_exch_capcty_nh4oacph7
clay_sized_carbonate
clay_total_separate
component_kind
component_name
component_percent
corrosion_concrete
corrosion_uncoated_steel
diag_horz_feat_depth_to_botm
diag_horz_feat_depth_to_top
diag_horz_feat_kind
diag_horz_feat_thickness
earth_cover_kind_level_one
earth_cover_kind_level_two
effective_cation_exch_capcty
electrical_conductivity
elevation
erosion_accelerated_kind
erosion_class
excavation_difficulty_class
excavation_difficulty_moist_st
exists_on_feature
extractable_acidity
extractable_aluminum
flooding_duration_class
flooding_frequency_class
fragment_hardness
fragment_kind
fragment_roundness
fragment_shape
fragment_size
fragment_volume
free_iron_oxides

geomorph_feat_modifier
geomorph_micro_relief
geomorphic_feat_id
geomorphic_position_flats
geomorphic_position_hills
geomorphic_position_mountains
geomorphic_position_terraces
gypsum
hillslope_profile
horizon_depth_to_bottom
horizon_depth_to_top
horizon_designation
horizon_thickness
horz_desgn_discontinuity
horz_desgn_letter_suffix
horz_desgn_master
horz_desgn_master_prime
horz_desgn_vertical_subdvn
hydrologic_group
iron_oxalate
linear_extensibility_percent
liquid_limit
local_phase
major_component_flag
manner_of_failure
mean_distance_between_rocks
month
organic_matter_percent
parent_material_general_mod
parent_material_group_name
parent_material_kind
parent_material_modifier
parent_material_order
parent_material_origin
particle_density
ph_01m_cacl2
ph_1_1_water
phosphorous_bray1
phosphorous_oxalate
phosphorous_total
phosphorous_water_soluble
plasticity
plasticity_index
ponding_depth

ponding_duration_class	slope_length_usle
ponding_frequency_class	sodium_adsorption_ratio
pore_continuity_vertical	soil_erodibility_factor_rf
pore_quantity	soil_erodibility_factor_whole
pore_shape	soil_moist_depth_to_bottom
pore_size	soil_moist_depth_to_top
potential_frost_action	soil_moisture_status
restriction_depth_to_bottom	soil_temp_depth_to_bottom
restriction_depth_to_top	soil_temp_depth_to_top
restriction_hardness	soil_temperature_mean_monthly
restriction_kind	stickiness
restriction_thickness	stratified_textures_flag
rock_frag_3_to_10_in	structure_grade
rock_frag_greater_than_10_in	structure_group_name
rupture_resist_block_cem	structure_id
rupture_resist_block_dry	structure_parts_to
rupture_resist_block_moist	structure_size
rupture_resist_plate	structure_type
rv_indicator	sum_of_bases_nh4oacph7
sand_coarse_separate	surface_frag_cover_percent
sand_fine_separate	surface_frag_hardness
sand_medium_separate	surface_frag_kind
sand_total_separate	surface_frag_roundness
sand_very_coarse_separate	surface_frag_shape
sand_very_fine_separate	surface_frag_size
sat_hydraulic_conductivity	t_factor
shape_across	terms_used_in_lieu_of_texture
shape_down	texture_class
sieve_number_10	texture_modifier
sieve_number_200	texture_modifier_and_class
sieve_number_4	total_subsidence
sieve_number_40	unified_soil_classification
silt_coarse_separate	water_fifteen_bar
silt_fine_separate	water_one_tenth_bar
silt_total_separate	water_one_third_bar
slope_aspect_clockwise	water_satiated
slope_aspect_counterclockwise	wind_erodibility_group
slope_aspect_representative	wind_erodibility_index
slope_gradient	

* Soil performance elements (range and forest production, etc.) and linkage to ecological site related data are not included as being required to be joined, but they should at least be coordinated between surveys.

Exhibit 609-3 Initial Field Review Checklist for Initial Soil Surveys and for Update Soil Surveys Requiring Extensive Revision.

(Completed by the review leader)

- Review completed mapping (digital or field sheets) for completeness
- Review acreage for completed mapping and map units
- Inspection of mapping in the field
- Review of taxonomic and map unit descriptions
- Review progressive correlation of map units
- Review Digital General Soil Map of the U.S. update and map unit descriptions
- Review Digital General Soil Map of the U.S. join
- Check join to adjacent surveys and among field sheets
- Review photographs and other figures for soil survey publication
- Review soil interpretations
- Review lab data
- Review classification of all pedons with lab data
- Review classification of all described pedons
- Compare typical pedon to the OSD
- Review transect/random sampling data
- Review statistical data
- Check documentation distribution and content
- Update databases
- Update long-range plan as needed
- Review memorandum of understanding
- Discuss development of annual plan for coming year
- Complete Quality Assurance Worksheet
- Complete comments, correlation notes, things-to-do, agreed-to-items, and commendable items
- Provide completed report to MLRA Regional Office
- Review proposed new soil series OSD and submit to MLRA Regional Office
- Circulate proposed new soil series for peer review
- Update soil data in field office technical guide
- Update OSD(s) as needed
- Update Soil Survey Schedule

Exhibit 609-4 Progress Field Review Checklist for Initial Soil Surveys and for Update Soil Surveys Requiring Extensive Revision.

(Completed by the review leader)

1) Review SSURGO spatial and attribute data for completeness
2) Review acreage for completed mapping and map units
3) Review of previous agreed-to-items, prepare response
4) Review field sheets in the office
5) Inspect field mapping
6) Review classification of all new lab data pedons
7) Review classification of all described pedons
8) Review comparison of all typical pedons to the OSD
9) Review all taxonomic and map unit descriptions
10) Continue progressive correlation approval
11) Review Digital General Soil Map of the U.S. legend and descriptions
12) Review Digital General Soil Map of the U.S. join
13) Check join to adjacent surveys and among field sheets
14) Review spot check of map digitizing
15) Review photographs for the soil survey publication
16) Review database entries and interpretations
17) Order or review set of interpretation tables
18) Review lab data
19) Review transect/random sampling data
20) Review statistical data
21) Check documentation distribution and content
22) Update long-range plan as needed
23) Review memorandum of understanding
24) Discuss development of annual plan for coming year
25) Complete Quality Assurance Worksheet
26) Complete comments, correlation notes, things-to-do, agreed-to-items, and commendable items
27) Provide completed report to MLRA Regional Office
28) Review proposed new soil series OSD(s) and submit to MLRA Regional Office
29) Circulate proposed new series for peer review
30) Update soil data in the Field Office Technical Guide
31) Update OSD(s) as needed
32) Provide OSD(s) and checklist tables to project office
33) Update Soil Survey Schedule
34) Review special studies data, such as yield data, water table, data
35) Review or schedule other discipline assistance
36) Review soil survey information program and activities
37) Review check plots of digitized quads

Exhibit 609-5 Final Field Review Checklist for Initial Soil Surveys and for Update Sol Surveys Requiring Extensive Revision.

____

(Completed by review leader)

1) Review SSURGO spatial and attribute data for completeness
2) Review previous agreed-to-items, prepare response
3) Review field sheets in the office
4) Review acreage for completed mapping and map units
5) Review classification and geo-reference of all described pedons
6) Review comparison of all typical pedons to the official series description
7) Review classification of all new lab data pedons
8) Review all taxonomic and map unit descriptions
9) Review documentation distribution and content
10) Review legend and descriptions for Digital General Soil Map of the U.S
11) Check join for Digital General Soil Map of the U.S. update
12) Check join among field sheets
13) Review cartographic spot check of map digitizing
14) Review photographs for the soil survey publication
15) Check line work and database for the join with adjacent surveys
16) Review soil interpretations and all NASIS entries
17) Review lab data
18) Review transect/random sampled data
19) Review statistical data
20) Complete correlation approval
21) Review completed legend
22) Update laboratory database for correlated names and classifications
23) Review memorandum of understanding
24) Discuss development of annual plan for completion
25) Complete Quality Assurance Worksheet
26) Review preliminary correlation if prepared
27) Complete correlation notes, things-to-do, agreed-to-items, and commendable items
28) Prepare final field review report
29) Prepare preliminary correlation memorandum without certifications and state conservationist transmittal, attach to final field report
30) Update official series descriptions (OSD), Soil Classification files, and NASIS
31) Provide official series descriptions, soil interpretations information, and checklist tables to project office
32) Update Soil Survey Schedule
33) Review check plots of digitized quads
34) Review complete report draft

Exhibit 609-6 Project Review Checklist for MLRA Soil Surveys

_________________________MLRA Soil Survey Area, ________________

(Completed by review leader)

1) Review previous agreed-to-items, prepare response
2) Review SSURGO spatial and attribute data for completeness
3) Review spatial and attribute revisions in the office
4) Review classification and geo-reference of all described pedons
5) Review changes or proposed revisions to the official series description
6) Review classification of all new lab data pedons
7) Review documentation distribution and content
8) Review legend and descriptions for Digital General Soil Map of the U.S.
9) Check join for Digital General Soil Map of the U.S. update
10) Review photographs and other figures for the soil survey publication
11) Check line work and database for the join with adjacent areas
12) Review soil interpretations and all NASIS entries
13) Review lab data
14) Review transect/random sampled data
15) Review statistical data
16) Complete correlation approval of map units
17) Review completed legend
18) Update laboratory database for correlated names and classifications
19) Discuss development of annual plan (if needed) for completion
20) Complete Quality Assurance Worksheet
21) Complete correlation notes, things-to-do, agreed-to-items, and commendable items
22) Prepare project review report
23) Review correlation documentation in NASIS for completeness.
24) Submit updated official series descriptions (OSD) and Soil Classification
25) Update Soil Survey Schedule
26) Review check plots of digitized quads

Exhibit 609-7 Outline of Items Considered in a State Management Review for Soil Survey.

A. Objectives and Plans

1. Long-range plan and priorities
   a. Soil survey evaluations
   b. Soil survey maintenance
   c. Soil survey areas
2. State soil survey conference
3. Memorandum of understanding for soil survey areas
4. Cooperative and contribution agreements for soil survey activities
5. Annual, monthly, weekly plans of operation

B. Personnel and Schedules

1. Previous soil survey appraisals
2. Staffing and assignments
3. Workload analysis and scheduling
4. Soil Survey Schedule
5. State and local contributions to the National Cooperative Soil Survey
6. Cooperative relations
   a. Other federal agencies
   b. State agencies and representatives
   c. Local agencies and representatives
7. Training given and received
8. Adherence to EO/Civil Rights policies and procedures

C. Field Operations and Quality Control

1. Soil survey automation at all levels
2. Status of digitizing soil maps
3. Status of imagery
4. Interdisciplinary needs and inputs to soil survey
5. Quality control procedures used
6. Soil survey appeals and disposition
7. Archival of soil survey records
8. Adherence to policies in the National Soil Survey Handbook
9. Application of technology, such as computers, field equipment, ground penetrating radar, global positioning systems, and remotely sensed data, to increase efficiency

D. Soil Interpretations

1. Maintenance of database
2. Maintenance of field office database
3. Guidelines and criteria used for developing national, state, and local interpretations
4. Updating and coordinating interpretations in state by major land resource areas
5. Status of automated soil survey interpretation development and application (GIS, Pedon-PC, and other)
6. Status of special lists, such as prime farmlands, hydric soils, and highly erodible land
7. Technical guides
8. Training given and received

E. Field and Laboratory Investigations

1. Plan for soil survey investigations
2. Existing laboratory data availability
3. Coordination of field and laboratory studies
4. Benchmark soil data
5. Special projects and interagency coordination
6. Reference sampling for interpretations, classification, and correlation

F. Preparation and Processing of Maps and Text for Publication

1. SSURGO review
2. Publication development

G. Soil Survey Use

1. Effectiveness and use of soil surveys, whether or not they meet objectives
2. Inventory of published soil surveys
3. Information activities
4. Procedures for distributing published soil surveys
5. Advance information
6. Special and interim reports
7. Supplemental reports

Exhibit 609-8 Quality Assurance Worksheet for Initial Soil Surveys and for Update Soil Surveys Requiring Extensive Revision. (subject to change by the MLRA Regional Offices to reflect local conditions)

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

QUALITY ASSURANCE WORKSHEET

MLRA _________

_________________________ County, State
________ (stssaid)

(date)

This quality assurance report is to ensure that: the soil survey is science-based; that the legend and correlation use the MLRA concept; and that the survey meets the standards and specifications of the National Cooperative Soil Survey.

CONTENTS

All negative responses identified in this report must be adequately addressed in a narrative.
QUALITY ASSURANCE REVIEW

____________ County, State - a subset of MLRA(s) ________
(date)

GENERAL INFORMATION and SCHEDULING

Agency in charge of survey:

Cooperating agencies:

Survey team (name and agency):

Total acres (land, census water):

Acres updated/mapped and percent of survey:

Status of Memorandum of Understanding (e.g. current, signed)

List quality assurance reviews (type and date):

Scheduled date - next quality assurance review:

Scheduled date - mapping completion:

Scheduled date - final correlation:

Scheduled date - publication to the MLRA Regional Office for technical review:

Scheduled date - map compilation completion:

Participants at this review:

MANAGEMENT ISSUES

______ Are deficiencies and agreed-to items stated in previous Quality Assurance Reviews satisfied?

______ Are management documents for the survey (e.g. Strategic Plan, Annual Plan of Operations) and standards of performance current?

______ Are any management problems associated with this survey?

______ Is the survey party accessing and using the latest versions of the NSSH, Keys to Soil Taxonomy, MLRA Regional Office technical notes and other guidance documents, past quality assurance reports, and other relevant documents?

______ Is the information in the soil survey schedule correct?

List in the narrative the specific technical training needs of soil survey staff not already identified by the local staff as part of their development plans.

CORRELATION and DESCRIPTIVE LEGEND

All map units correlated must have data to support the correlation -- if not from the subset, then from the MLRA. The MLRA concept must be used for developing the legend.

______ Do all project members and participants understand the concept of map units, data map units and the MLRA process?

One legend is maintained for the survey containing the provisional and the approved map units for the MLRA. The legend is the official, progressively correlated subset legend of the MLRA. The map units in the legend have been approved by the MLRA Regional Office. The legend contains "provisional" map units that are being mapped but that have insufficient acreage or documentation. The type and amount of documentation required for the map units to become approved depends on the complexity of the map unit, existing documentation for the map unit within the MLRA, and previous correlation decisions.

Attach the legend. Include a list of map units added, dropped, or changed since the last review. Summarize the documentation gathered and provide a narrative of the field stops seen on this review.

______ Is documentation sufficient for approved data map units on the legend?

______ Do all new components (series) of map units to be added to the legend classify properly in accordance with current soil taxonomy?

______ Are the properties (representative values) of all new components of map units as mapped in the survey area within the range of the named series?

______ Is the official soil series description up-to-date for all series used in the survey area (georeferenced, classification current, metric units of measure, horizon nomenclature current, competing series current, diagnostic horizons and features listed)?

______ Have names for new series been reserved and a description provided for the OSED database?

______ Are the map unit names and design consistent with the MLRA soil survey area for this initial soil survey?

______ Are all proposed changes in the legend recorded and reported in the appropriate NASIS tables?

______ Are notes recorded in NASIS detailing the location and acreage of provisional map units until they are approved for the ID legend?

______ Is a strategy in-place for gathering documentation and are there instructions as to kind and quality of field notes needed?

______ Does each project member have an up-to-date copy of the descriptive legend?

______ Is the descriptive legend adequate to ensure consistency of the mapping by all project members and to ensure a timely completion of the publication?

______ Are the pedon descriptions stored in NASIS?

______ Are field notes, transect data, and laboratory data summarized regularly? Is the descriptive legend brought up to date?

______ Is a conversion legend generated? Is it up-to-date?

The project leader is responsible for updating the section "Notes to Accompany Classification and Correlation of the Soils." Refer to NSSH exhibit 609-1, item 17 for an example. Attach the notes or the plans for developing this document.

SOIL INVESTIGATIONS

______ Is a soil investigation work plan prepared and approved by the MLRA Regional Office?

______ Is the soil classification of lab data current with soil taxonomy?

______ Are pedons properly classified? Is the disposition of the laboratory data given and provisions made to update the laboratory database?

The project leader is responsible for updating the section "Classification of Pedons Sampled for Laboratory Analysis." Refer to NSSH exhibit 609-1, item 15 for an example. Attach the document or the plans for developing this document.

SOIL MAPPING

Describe in a narrative the process used by the survey project office to ensure:

quality control of mapping and approval by the project leader;

an exact join as described in NSSH 609.03; or an acceptable join with

join statements to allow an exact join in the future (consider metadata)

______ Is there a process for ensuring security of the original maps, compiled maps, and data files (e.g., fire-safe copies, back-up disks at a secure location, etc.)?

Attach a list of field sheets reviewed

______ Is recent and/or update mapping consistent throughout the subset and MLRA?

______ Does the map unit design represent the landscape/landform position, and other information in the data map unit?

______ Do map unit boundaries generally conform to landscape features and other features visible on the photo base?

______ Is the level of detail in mapping consistent and does the level of detail conform to the specifications in the memorandum of understanding?

______ Do map sheets join?

______ Is Features and Symbol Legend for Soil Survey 37A (exhibit 627-5) applied properly and consistently?

______ Is the 37A current and are major/minor codes completed?

______ Are typical pedons located in a delineation with the component named?

______ Is there a system in place to track for each field sheet, the surveyors name, dates, acreage mapped, acreage reported, and date of completion of the field sheet?

______ Do completed maps show: survey name and state, date of survey, name of soil scientist, "advance copy"?

______ Are legible and oriented symbols in all delineations?

______ Are typifying pedons accurately georeferenced?

______ Are all ad hoc features clearly defined?

______ Where appropriate, are section corners marked?

______ Is a progress map maintained?

______ Is the general soil map concurrent with mapping?

MAP COMPILATION and DIGITIZING

If applicable, describe the process to ensure quality control of map compilation activities (100% check)

______ Is the compilation performed according to the NRCS specifications as described in the NSSH, part 647?

______ Is the soil survey compiled to NRCS approved base maps?

______ Do compiled map unit delineations and their symbols match across map boundaries? Has an exact or acceptable (choose one for each adjacent survey) join been achieved with adjacent surveys?

______ Do plans ensure a 100% edit of the compilation prior to sending the maps to the MLRA Regional Office for quality assurance and map compilation certification?

Attach plans to digitize the survey, including plans for preparing the maps for publication.

PUBLICATION PREPARATION

Date the following publication items that are complete. Address incomplete items in the narrative. Note: not all of the items listed below are required for a publication (see part 644).

______ Map unit descriptions

______ Taxonomic unit descriptions

______ General soil map

______ General soil map unit descriptions

______ Edited pre-written material

______ General Nature of the County section

______ Climate tables and narrative

______ Interpretive tables

______ Database populated for generation of interpretations and map unit descriptions

______ Pictures and captions

______ Block diagrams or other graphics

______ Input from appropriate partners

______ Input from other disciplines

______ Soil formation section

______ Use and management narratives

______ Draft publication for technical review

NASIS and DATABASES

______ Is NASIS being populated by the soil survey office staff?

______ Are data elements for all map unit components (including miscellaneous areas as appropriate) being populated sufficiently with data to meet nationally mandated requirements as well as state and local needs?

Attach plans to populate the database. Include NASIS training received and training needed for all project members, along with the staff member(s) who have responsibility for editing.

INTERPRETATIONS

______ Are existing interpretations adequate for the purposes of the survey as described in the memorandum of understanding?

______ Are interpretive ratings being reviewed and tested?

In a narrative, describe:

What special interpretations or interpretive tables are needed?

What assistance have other disciplines provided or scheduled for making, testing, and coordinating interpretations?

What soil performance data (e.g. crop yields, site indices) are collected and how?

MISCELLANEOUS ISSUES

Attach responses to these in a narrative:

What are the roles and responsibilities of the resource soil scientist with this survey? Conversely, what are the roles and responsibilities of the survey party with the resource soil scientist?

What input and involvement is there from soil survey partners?

Describe the survey party's involvement with technical soil services (i.e. CRP, soil quality, global climate change, FOTG, etc.).

What are the plans for certifying and updating the field office technical guide?

Does this office have adequate Internet access to run NASIS, obtain OSEDS, download laboratory data from NSSL, view the NSSH, etc? If not, state plans to obtain access.

What are the plans to provide advanced information and support to users?

How is the survey being publicized?

What are the plans to update the Digital General Soil Map of the U.S. (STATSGO) when the survey is completed?

Other issues

ATTACHMENTS and NARRATIVES

All negative responses are to be addressed. In addition, include the following with this report:

Identification legend
Provisional legend
List the map units added, dropped, or changed
Conversion legend
Summary of documentation

Field stops report
Notes to accompany classification and correlation of the soils
Classification of pedons sampled for laboratory analysis
Field sheets reviewed
Plans to digitize the survey, including plans for preparing the maps for publication
How publication items planned but not completed are being addressed
Technical training needs
Response to miscellaneous issues
Quality control process of soil maps
Quality control process of soil compilation (if applicable)
Plans to populate the database
Commendable items
Recommended or significant items
Action items (agreed-to items)

SIGNATURE PAGE

We, the undersigned, have reviewed this report and concur with its findings.

____
Project Leader date

____
Soil Data Quality Specialist date

____
NCSS Partner(s) date

____
State Soil Scientist date

____
NRCS Management (AC, Team Leader, etc) date

CERTIFICATION

As of ________________, this soil survey meets the standards and specifications of the National Cooperative Soil Survey. The survey is science-based and joins adjacent survey areas using the MLRA concept.

____
Region __ MLRA Regional Office Leader

Exhibit 609-9 Quality Assurance Worksheet for MLRA Soil Surveys (subject to change by the MLRA Regional Offices to reflect local conditions)

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

QUALITY ASSURANCE WORKSHEET

MLRA __________

__________________________ MLRA SSA
________ (MLRAssaid)

(date)

This quality assurance report is to ensure that: the soil survey is science-based; that the legend and correlation use the MLRA concept; and that the survey meets the standards and specifications of the National Cooperative Soil Survey.

CONTENTS

All negative responses identified in this report must be adequately addressed in a narrative.

QUALITY ASSURANCE REVIEW

____________ MLRA project area- a subset of MLRA(s) ________
(date)

GENERAL INFORMATION and SCHEDULING

Agency in charge of survey:

Cooperating agencies:

Survey team (name and agency):

Total acres (land, census water):

Acres updated/remapped and percent of survey:

List quality assurance reviews (type and date):

Scheduled date - next quality assurance review:

Scheduled date - project completion:

Participants at this review:

MANAGEMENT ISSUES

______ Are deficiencies and agreed-to items stated in previous Quality Assurance Reviews satisfied?

______ Are management-related documents current (e.g. workload analysis - long range plan, project plan of operations, annual plan of operations, standards of performance, individual training plans)?

______ Are any management problems associated with this survey?

______ Is the survey party accessing and using the latest versions of the NSSH, Keys to Soil Taxonomy, MLRA Regional Office technical notes and other guidance documents, past quality assurance reports, and other relevant documents?

______ Is the information in the soil survey schedule correct?

List in the narrative the specific technical training needs of soil survey staff not already identified by the local staff as part of their development plans.

CORRELATION

One legend is maintained for the survey containing the provisional and the approved map units for the MLRA. The legend is the official, progressively correlated subset legend of the MLRA. The map units in the legend have been approved by the MLRA Regional Office. The legend contains "provisional" map units that are being mapped but that have insufficient acreage or documentation. The type and amount of documentation required for the map units to become approved depends on the complexity of the map unit, existing documentation for the map unit within the MLRA, and previous correlation decisions.

Attach the legend. Include a list of map units added, dropped, or changed since the last review. Summarize the documentation gathered and provide a narrative of the field stops seen on this review.

______ Do all project members and participants understand the concept of map units, data map units, and the MLRA process?

______ Is documentation sufficient for approved data map units on the legend?

______ Do all new components (series) of map units to be added to the legend classify in accordance with current soil taxonomy?

______ Are the properties (at least the representative values) of all new components of map units as mapped in the survey area within the range of the named series?

______ Is the official soil series description up-to-date for all series used in the survey area (georeferenced, classification current, metric units of measure, horizon nomenclature current, competing series current, diagnostic horizons and features listed)?

______ Have names for new series been reserved and a description uploaded to the OSED database?

______ Are the map unit names and design consistent with purposes and scale of the MLRA soil survey area?

______ Are all proposed changes in the legend recorded and reported in an accepted systematic procedure?

______ Is a strategy for gathering documentation in-place and are there instructions as to kind and quality of field notes needed?

______ Are the pedon descriptions stored in NASIS?

______ Are field notes, transect data, and laboratory data summarized regularly?

______ Is a conversion legend generated? Is it up-to-date?

SOIL INVESTIGATIONS

______ Is a soil investigation work plan prepared and approved by the MLRA Regional Office?

______ Is the soil classification of lab data current with soil taxonomy?

______ Are pedons properly classified? Is the disposition of the laboratory data given and provisions made to update the laboratory database?

SUPPLEMENTAL SOIL MAPPING

Describe in a narrative the process used by the survey project office to ensure:

quality control of supplemental mapping and approval by the project leader;

an exact join as described in NSSH 609.03;

Attach a list of spatial data reviewed

______ Is supplemental mapping consistent throughout the subset and MLRA?

______ Does the map unit design represent the landscape/landform position, and other information in the data map unit?

______ Do map unit boundaries generally conform to landscape features and other features visible on the imagery?

______ Is the level of detail in mapping consistent and does the level of detail conform to the objectives of the project plan?

______ Is Features and Symbol Legend for Soil Survey 37A (exhibit 627-5) applied properly and consistently?

______ Is the 37A current and are major/minor codes completed?

______ Are typical pedons located in a delineation with the component named?

______ Are typifying pedons accurately georeferenced?

______ Are all ad hoc features clearly defined?

______ Is a progress map maintained?

______ Is the provisional Digital General Soil Map of the U.S. (STATSGO) map concurrent with mapping?

SSURGO DEVELOPMENT and REVISIONS

______ Do digitized map unit delineations and their symbols match across project boundaries? Has an exact join been achieved with adjacent MLRA project surveys?

______ Do plans ensure a 100% edit of the digitizing prior to sending the files to the MLRA Regional Office for quality assurance and digitizing certification?

NASIS and DATABASES

______ Are all data elements for all map unit components including miscellaneous areas populated with data?

Attach plans to populate the database. Include NASIS training received and training needed for all project members, along with the staff member(s) who have responsibility for editing.

INTERPRETATIONS

______ Are interpretations consistent with the purposes of the survey as described in the project plan?

______ Are interpretive ratings being reviewed and tested?

In a narrative, describe:

What special interpretations or interpretive tables are needed?

What assistance have other disciplines provided or scheduled for making, testing, and coordinating interpretations?

What soil performance data (e.g. crop yields, site indices) are collected and how?

MISCELLANEOUS ISSUES

Attach responses to these in a narrative:

What are the roles and responsibilities of the resource soil scientist(s) with this project? Conversely, what are the roles and responsibilities of the survey party with the resource soil scientist(s)?

What input and involvement is there from soil survey partners?

Describe the survey party's involvement with technical soil services (i.e. CRP, soil quality, FOTG, onsite investigations, etc.).

What are the plans for the state certifying and updating the field office technical guide?

What are the plans to update Digital General Soil Map of the U.S. - STATSGO when the survey is completed?

Other issues

ATTACHMENTS and NARRATIVES

All negative responses are to be addressed. In addition, include the following with this report:

Identification legend
Provisional legend
List the map units added, dropped, or changed
Conversion legend
Summary of documentation
Field stops report
Notes to accompany classification and correlation of the soils
Classification of pedons sampled for laboratory analysis
SSURGO data reviewed
Web Soil Survey reviewed
Technical training needs
Response to miscellaneous issues
Quality control process of soil maps
Plans to populate the database
Commendable items
Recommended or significant items
Action items (agreed-to items)

SIGNATURE PAGE

We, the undersigned, have reviewed this report and concur with its findings.

____
MLRA Soil Survey Office Leader date

____
Soil Data Quality Specialist date

____
NCSS Partner(s) date

____
State Soil Scientist date

____
State Soil Scientist date

____
NRCS Management (AC, Team Leader, etc.) date

CERTIFICATION

As of ________________, this soil survey meets the standards and specifications of the National Cooperative Soil Survey. The survey is science-based and joins adjacent MLRA survey areas

____
Region __ MLRA Regional Office Leader

Exhibit 609-10 Quality Control Template for Initial Soil Surveys (subject to change to reflect local conditions)

INITIAL SOIL SURVEY
QUALITY CONTROL REVIEW

Date:

Area name:

State Soil Survey Area Identification:
Major Land Resource Area(s):

This quality control report is to ensure this soil survey is science-based, the legend and correlation use the MLRA concept, and the survey meets the standards and specifications of the National Cooperative Soil Survey. This report consists of several soil survey functions. Each function (legend, soil mapping, database, etc.) can be completed at different times of the year depending on the flow of work during the year. However, after one year each function should be reviewed. As a function is reviewed, the document should be signed off and sent to the MO for a quality assurance check.

GENERAL INFORMATION AND SCHEDULING

Agency in charge of survey:

Cooperating agencies:

Total acres from NASIS (see legend/legend land category): land _________; census water

Status of Memorandum of Understanding:

Scheduled date - mapping completion:

Scheduled date - final correlation:

Scheduled date - manuscript to the State office for technical review:

- manuscript to the MLRA Regional Office for technical review:

Scheduled date - map digitizing completion:

Has a workload analysis-plan of operations been developed? _________

Does the project office have an official electronic soil survey area boundary? _________

What soil surveys does the project survey match to and what is the status of each survey:

1) ____

2) ____

3) ____

4) ____

For each adjoining soil survey, **ATTACH** a list of map units requiring a join by soil survey area

NASIS: Provide location where NASIS tabular data is stored and edited:

Area Symbol ______________________________

Area Name ______________________________

Survey Status ______________________________

Is soil mapping being compiled and digitized to the imagery to be used for "publication"?.

Data and Source of imagery ______________________________

Will the survey have a general soil map? ______________________________

Will the survey have a "published" soil survey report? ______________________________

If yes, list the manuscript sections and NASIS generated reports/tables to be included (this may change as reports are updated or revised)

____

____

____

____

____

____

____

Comments:

The above items have been reviewed for completeness and adherence to NCSS standards.

______________________________ ______________

MLRA Soil Survey Project Leader Date

PROGRESS AND LEGEND

Date

1) Cumulative total of acres reported as mapped in NASIS (see Legend / Legend Mapping Progress):

-

2) Are **ALL** map symbols on the official soil maps for the survey in the legend:

- **ATTACH** a legend from NASIS by map unit status
- **ATTACH** a legend from NASIS by map unit name and include the additional symbols
- **ATTACH** the SOI-37A indicating miscellaneous features and ad hoc features
- **ATTACH** a list of map units added to the legend since the last quality control review
- **ATTACH** a list of map units correlated or dropped since the last quality control review and include a correlation note report from NASIS identifying reason for decisions

- Does the legend contain all map units from adjacent surveys in order to have and exact join?_______If no, list the map units that are matching but not in the legend:

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

________________________ ____________

MLRA Soil Survey Project Leader Date

TYPICAL PEDONS

Date__________________

- For each series or higher taxa in the legend, is the typical or representative pedon entered into NASIS pedon?__________________ If no, list the series or taxa not in NASIS pedon:

- Are all new series names used in approved map units reserved? __________ If no, what names are not reserved?

- Are all series and higher taxa properly classified using Soil Taxonomy?

  ATTACH a classification table from NASIS

- Provide a list of all soil series (OSDs) having their type location in the survey area :
  -
- Are all typical pedons for series and higher taxa located within the survey area?
  -

  If no, list the series or higher taxa and the survey area in which it occurs:

- List the typical pedons (and its range of characteristics) reviewed and compared to the OSD:

List the OSDs to be submitted to the MO for revision with a proposed date for submission:

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

____________________ ____________

MLRA Soil Survey Project Leader Date

DATABASE

Date__________________

- Are all map units in the legend table linked to a data map unit (DMU) thru the correlation table?

  -

  If no, list the map units that are not linked to a DMU.

  -

- Are all components (major and minor) to be fully populated?_______

- MO-X Technical Note ZZ provides guidance on reviewing Soil Survey Data Quality in NASIS.

  - List the map units and associated data map units reviewed:

  o List the Standard Reports as identified in Tech. Note 38 that were used to review data quality (for example):

    * UTIL – Comparison of LL and PI, stored vs. calculated (National)

    * UTIL – T. Factor Validation (National)

    * CORR – Slopes and Climate Data (MO-X)

  o List the NASIS Validations as identified in MO Tech. Note XX that were used to review data quality (for example):

    * Component / Horizon

      percent passing sieves

      particle-size distribution

    * Horizon Texture Group

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

______________________ ____________

MLRA Soil Survey Project Leader Date

MAP UNIT DESCRIPTIONS

Date_______________

- List the NASIS MUG report to be used for the soil survey:

  -

- List the map unit descriptions reviewed for quality and quantity of data populated:

  ____

-

For each map unit description reviewed, identify data voids or data elements needing review (see MO-X Tech. Note XX for data population guides):

Map Unit Symbol	Database element needing review

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

_______________ _______________

MLRA Soil Survey Project Leader Date

SOIL MAPPING

Date____________________

- What are the official soil maps for the survey (field sheets, compilation sheets, digital files/plots)?

  ____

- What is the minimum size polygon (acres) to be delineated?

  -

- **ATTACH** a small scale soil mapping progress map for the survey area.
- List the field sheets reviewed along with date reviewed:

-

-

Review

- o Are all symbols on the maps in the NASIS legend?_______________If no, which symbols are missing?

  -

- o Do map unit polygons conform to landforms, landscapes and are their segments visible on the photo base?

  -

- o Are all miscellaneous or ad hoc features on the maps, identified on the SO1-37A? If no, which features are on the maps but not on the 37A?

  -

- o Is the use of the feature symbol(s) consistent across the soil survey extent?

  -

- o Are size of polygons consistent with specifications in the MOU?

  -

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

_________________________ _____________

MLRA Soil Survey Project Leader Date

DOCUMENTATION

Date________________

- List the map units in which transects were made since the last quality control review to determine map unit kind and composition:

-

-

  - Are the transect locations georeferenced with a GPS unit?

Has a spatial documentation layer in GIS been created. This layer would document by polygon, how the map unit was determined. Each polygon would be coded using a legend. For example: 1. transect made in polygon, 2. polygon was visited to confirm map unit, 3. polygon was observed with "high" degree of confidence; 4. polygon was observed with "low" degree of confidence, 5. polygon was remotely sensed.

- For each new series proposed how many complete pedon descriptions are available? List series name and number of descriptions:

-

-

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

____________________ ____________

MLRA Soil Survey Project Leader Date

COMPILATION AND DIGITIZING

Date__________________

- Describe the map compilation and digitizing process being used for the soil survey:

-
-
-

- Provide the following information for off-site security of soil maps:

  Location of site ____

  Date of last security update __________________________________

  Type of security material: paper or electronic ______________________

- List the compilation sheets (quads) reviewed and digital sheets reviewed, along with date reviewed:

-
-

For each sheet reviewed, list issues or concerns:

Map Sheet (Quad)	Issues/Concerns

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

____________________________ ______________

MLRA Soil Survey Project Leader Date

INVESTIGATIONS

Date:____________________

- Are there plans to have a project investigation within the survey area? ____________ If yes, when is the projected date for sampling?

  -

- List all pedons sampled within the survey area. This list will consist of all pedons sampled for laboratory analysis (reference and complete characterization). This will be a running list from year to year. For example:

Sampled as Name	Map Unit Symbol	Pedon ID	Laboratory	Site ID
Cosbie	2017	050R035003	NSSL	99-JFD-04

Comments:

Action or Recommended Items:

The above items have been reviewed for completeness and adherence to NCSS standards.

______________________ ____________

MLRA Soil Survey Project Leader Date

Part 610 - UPDATING SOIL SURVEYS

Table of Contents

Part 610 - UPDATING SOIL SURVEYS

610.00 Definition and Purpose.

(a) Updating of soil survey information is the continuous activity of data collection, reviews, evaluations, and additions to existing soil survey information.

(b) Updating soil survey information ensures that current and accurate seamless soil survey information is available to meet the needs of the majority of users.

(c) MLRA soil survey update projects are planned and organized to focus on specific groups of soils and their associated support data and interpretations.

(d) Update projects are generally coordinated across existing soil survey area boundaries and follow natural landforms.

610.01 Policy and Responsibilities.

(a) Policy

(1) Consider the MLRA as the overall project soil survey area.

(2) Analysis and update is by MLRA, stored in NASIS, and delivered as subsets.

(3) Correlation decisions are recorded in NASIS or, if not yet SSURGO-certified, with an amendment to the correlation document, as appropriate.

(4) Updates are based on a broad physiographic area, brought to a consistent level with joined data and soil delineations that follow natural landforms, and generally coordinated across existing soil survey area boundaries.

(5) Updating the mapping of an individual soil survey area without improving the join is unacceptable.

(6) Natural physiographic areas within the MLRA (i.e., specific groups of soils or natural landforms) can be identified as update projects.

(7) The existing project soil surveys of counties or other boundaries within the MLRA can be identified as subsets if identified as needing extensive revision; see 610.04(a)(2)(i).

(8) The MLRA workload analysis - long-range plan brings each of the existing soil surveys in the MLRA to the standard defined by the MLRA Region-wide memorandum of understanding. Base the plan on information developed by the state soil scientists and other cooperators responsible for setting priorities for soil surveys (see 608.06). Exhibit 608-3 illustrates a sample workload analysis - long-range plan for a MLRA. Identify specific priorities within the MLRA that can be accomplished in about 2 to 5-years and develop subsequent annual plans of operation to guide and provide specific focus to staff as the 2 to 5 year projects are being implemented.

(9) Official soil survey attribute data, and to the extent possible, all other official soil survey information (maps, interpretations, and metadata) are maintained in a central, sole-source repository (Soil Data Warehouse) and accessible electronically through various soil data marts. Official soil survey information (maps, data, interpretations, and metadata) is identified in the Field Office Technical Guide.

(10) Proposed revisions, modifications, and supplemental mapping are documented and, when determined appropriate by an evaluation of the soil survey, used to revise the official soil survey information. Revisions, modifications, supplemental mapping, or remapping require evaluation actions listed in 610.03.

(11) Bring soil surveys up to date within a major land resource area (MLRA). Ensure that surveys within the MLRA have common soil polygon lines and features and share basic soil properties and selected soil qualities (see Exhibit 609-2).

(12) Coordinate and utilize common standards for updating soil survey information within the MLRA with those established and defined in the MLRA Region-wide memorandum of understanding. Specific details can be included in the workload analysis – long-range plan and the project plan of operations as needed.

(13) Use a common map scale, map unit symbol, map unit name, map unit design, and mapping intensity within broad physiographic areas to provide soil information at a level commensurate with most user needs.

(14) All revisions to soil surveys are part of a MLRA project.

(b) Responsibilities

Primary responsibility for various aspects of updating soil surveys is with state offices, MLRA Regional Offices (MO), MLRA Soil Survey Offices (SSO), and on some federal lands, NCSS partner agencies. The General Manual, Title 430, Part 402, Subpart B, outlines responsibilities of these offices and other soil survey business areas. In addition to the following responsibilities, refer to part 608.01 for a partial overview of responsibilities.

(1) MLRA Regional Offices (MO)

(i) Coordinates with the states to develop a plan that addresses the routine maintenance of existing NASIS datasets. The purpose of the plan is to minimize the risk of data being included that does not meet NCSS standards, that is inconsistent with data in adjoining areas of the same soils, and that is of unknown origin. The plan builds quality control and quality assurance into the editing process. The plan may include information such as:

- a list of individuals who have permissions to edit the data;
- actions to obtain needed training;
- a list of data map units and data elements expected to be addressed;
- guidance documents, algorithms, and other aids to be used; and
- a schedule of when work will be done.

(ii) Assures the quality of all new and revised soil survey data in the region.

(iii) Conducts a quality assurance review of the revised spatial data.

(iv) Manages the assignment of editing permissions in NASIS.

(v) Assures that individuals with editing privileges are properly trained.

(vi) Approves changes to the legend that are proposed by the MLRA Soil Survey Office.

(2) State Offices. As program managers, state soil scientists:

(i) are responsible for conducting evaluations of non-MLRA soil survey areas within their state to identify deficiencies, problems, and needs;

(ii) assign competent, trained individuals within the state to edit data in NASIS as necessary to carry out program responsibilities;

(iii) inform the MO of work being performed by them on the database and request edit privileges as needed; and

(iv) notify the appropriate area and field offices, and affected partner agencies of major revisions to the database.

(3) MLRA Soil Survey Offices (SSO)

(i) Develop, manage, and update all map unit information.

(ii) Propose changes to the legend, such as component names used in the map unit name.

(iii) Correct errors, obsolete terms, and null data. Data searches of these errors constitute an evaluation and change over the extent of the mapping unit and additional evaluation actions are not needed. Entries or corrections to data entries are made at the time that the errors are discovered, including changes to taxonomic soil classification.

(iv) Inform the MO of work being performed by them on the database.

(v) Analyze the official soil survey legends of the MLRA and reconcile the map unit names in order to prepare a legend for the MLRA or for some portion thereof.

(vi) Compile a list of map unit names for the broad update area to facilitate the correlation of map units among individual soil survey areas within the area. Uniformly named map units and a consistent symbol legend enhance usability.

(vii) Update all data map units when combining map units during correlation.

(4) National Cartography and Geospatial Center (NCGC)

(i) Assist in the acquisition of best available digital elevation data, aerial photography, and orthophotography.

(ii) Provide subsets of the Digital Soil Map of the U.S.

(iii) Assist with the application of remote sensing and global positioning systems.

(iv) Provide training in GIS, GPS, remote sensing, and digital soil survey development.

(v) Provide geospatial web map services and image map services.

610.02 Workflow for Updating Soil Survey by Major Land Resource Area.

(a) Determine Requirements.

Major requirements are identified through the process of setting priorities described in part 608.06.

(b) Develop a Work Load Analysis – Long-Range Plan for the MLRA Soil Survey Area.

The MLRA Soil Survey Office consults the workload analysis – long-range plan to address the priority issues that have been identified for the MLRA soil survey area. The most important priorities are identified and narrowed down to a manageable workload that can be accomplished within about a 2 to 5 year period (see 608.07). A project plan of operations is developed to guide the work on these activities.

(c) Acquire and Integrate Existing Data.

To begin work, relevant existing data should be acquired and organized by the MLRA Soil Survey Office. Existing data may include:

(1) Soil Surveys in the MLRA

(i) Previously completed soil surveys

- (ii) Soil surveys for conservation planning
- (iii) Soil survey quality control data, including field notes and documentation
- (iv) Soil survey photographs, block diagrams, and other figures
- (v) Soil survey quality assurance documents
- (vi) Soil correlation memoranda and amendments

(2) Reference Maps

- (i) Original field sheets
- (ii) Major land resource area maps
- (iii) General soil map
- (iv) All available aerial photography and other remote sensing coverage
- (v) U.S.G.S. topographic and slope maps
- (vi) Public lands survey
- (vii) Maps and text on geology, geomorphology, geography and water resources
- (viii) Maps and text on vegetation and land use
- (ix) Climatic maps and data
- (x) Flood plain maps
- (xi) Maps and text on air resources
- (xii) U.S. Fish and Wildlife Service wetland maps

(3) Reports and Inventories

- (i) Census reports
- (ii) Crop reporting service reports
- (iii) Multi-spectral data
- (iv) River basin reports
- (v) State, regional, or county land use plans and regulations
- (vi) RC&D work plans
- (vii) Public lands management reports and inventories
- (viii) Bulletins and reports of State Agricultural Experiment Stations
- (ix) National Food Security Act Manual and similar manuals
- (x) National resource inventory data
- (xi) Field office technical guides
- (xii) Soil laboratory data

(4) Scientific and Research Reports and Data

- (i) Theses and dissertations of college or university students
- (ii) ICOM reports - wet soils, cold Aridisols, Aridisols, Andisols
- (iii) Articles in scientific and technical journals
- (iv) Well logs from local or state agencies
- (v) NRCS drainage, irrigation, and erosion control guides and maps
- (vi) Percolation test results from local agencies
- (vii) Highway soil test data
- (viii) Climate data

(ix) Geomorphology studies

(5) Forestry, Range, and Wildlife Inventories and Studies

(i) Forest inventories

(ii) Range inventories

(iii) Studies and reports on wildlife habitat recreational sites

(6) Official Soil Series and Soil Interpretations

(i) Soil interpretations information in the databases for the taxa assumed to be in the survey area

(ii) Official soil series descriptions

(iii) Archived copies of previous official series descriptions and soil interpretation records

(7) Databases

(i) Pedon database

(ii) National Soil Information System

(iii) State Soil Geographic (STATSGO) database

(iv) Soil Survey Geographic (SSURGO) database

(8) Digital Data

(i) Digital orthophotography

(ii) Digital raster graphic

(iii) Digital elevation model

(iv) Common land units

(v) Common Resource Areas

(vi) Digital hydrography, transportation, etc.

(d) Data Analysis

Using tools such as Soil Data Viewer, ArcGIS, and NASIS query functionality, analysis of the data by the MLRA Soil Survey Office is performed for consistencies, inconsistencies, and anomalies to be addressed. Landscape predictive models, such as those that are part of the Soil Resource Inventory Toolbox, as well as statistical software to analyze and summarize data can also be used as appropriate.

(e) Field Investigations And Data Collection

Field investigations may be needed to collect data identified in the previous step. The MLRA Soil Survey Office will check data out of the National Soil Geospatial Database (see 610.06). Sites are identified (preselected) during the data analysis phase and are statistically representative of the landscape and are large enough to sample. Use GPS to navigate to the site and collect data, including vegetative data, as documentation. Edit tabular and spatial data as appropriate.

(f) Laboratory Analysis

An investigation plan is part of the project plan of operations for the MLRA soil survey area. The investigation plan is developed by the MLRA Soil Survey Office Leader in consultation with the MO, partner agencies, and NSSL who will assist the MLRA Soil Survey Office Leader through expert consultation and providing regional and national coordination of investigations.

(g) Quality Control

The MLRA Soil Survey Leader is responsible for quality control of the soils information within the MLRA soil survey area. The MLRA Soil Survey Office Leader reviews data online as well as conducting site visits throughout the area (see 609.04).

(h) Quality Assurance

The MO Leader is responsible for quality assurance of the soils information within the entire MO area of responsibility (see 609.05). The MLRA Regional Office works closely with partner agencies on federal lands in carrying out quality assurance activities.

(i) Update Soil Data Warehouse and Soil Data Mart

After all field data is collected, analyzed, and populated into NASIS, the Soil Data Quality Specialist completes a quality assurance review of the process and a technical review of the spatial and attribute data. The State Soil Scientist is informed that the survey areas are complete and available for posting to the Soil Data Mart and to the Web Soil Survey. This process allows for a timely delivery of "updated" soil survey data.

610.03 Evaluating Deficiencies to be Corrected in Soil Survey Updates.

Each official non-MLRA initial soil survey area is evaluated within the context of the greater MLRA soil survey area for update needs. The goal is to bring all soil survey areas within the MLRA to a common, coordinated standard so that the MLRA can be viewed as one survey. The states that share the MLRA are all involved in the evaluation process.

The extent of the evaluations will depend on the current level of existing knowledge about each soil survey. For many soil survey areas, some knowledge is available from staff experience, records, or from those who participated in the previous soil survey. Users of a given soil survey may have kept records of deficiencies. Where existing information on deficiencies is available, an abbreviated evaluation process may be all that is needed. Where information is limited, a more structured evaluation is required. In either case, the result of evaluations summarizing deficiencies and recommendations for improvement is documented. Evaluation worksheets in Exhibits 610-1 and 610-2 are useful, particularly for soil surveys that have little or no information available to current staff.

(a) The Evaluation Process

Prior to any soil survey updating activity, an evaluation of the overall condition of the original survey areas is required. Evaluation of all soil survey areas within an MLRA should be done within a relatively short period (1 year or less), utilizing a consistent format. Evaluations include two major components:

(1) Determine current and projected user requirements and needs. The original soil survey memorandum of understanding records user needs and specifications for the survey at the time it was initiated and can be helpful in assessing the likely needs for update.

(2) Evaluate the spatial and attribute.

(b) Responsibilities and Coordination of Evaluations

The State Soil Scientist provides leadership and direction to the evaluation process within their respective state. The State Soil Scientist assures that the evaluation includes documentation related to the current quantity and quality of the soil survey data. This evaluation serves as an inventory and assessment of the data on file, and helps to direct the State Soil Scientist and the state soil survey partners in update projects.

(c) Evaluation Process

(1) Assemble, review, and summarize the existing documentation on file.
- (i) map unit descriptions
- (ii) unpublished soil information
- (iii) records documenting soil survey joining problems
- (iv) interpretations
- (v) correlation records
- (vi) field review reports
- (vii) special investigation and laboratory data
- (viii) pedon descriptions
- (ix) transect data
- (x) tacit knowledge of those experienced in the area
- (xi) notes of needed changes recorded in the office copy of the published soil

(2) Some examples of items to be considered when evaluating a soil survey include:
- (i) soil delineations conform to landform positions
- (ii) appropriate level of detail
- (iii) adequacy of the imagery
- (iv) land use change
- (v) map unit design/composition
- (vi) classification
- (vii) need for laboratory or other support data
- (viii) adequacy of the database to support interpretations

(3) Interview users of the data including NCSS cooperators, state and local government agencies, NRCS field office staff, Resource Soil Scientists, and Soil Scientists who worked in the survey area or in adjacent survey areas.

(4) Look for variability of soil delineations which may result from individuals' mapping style, differences in detail within and among soil survey areas, and the consistent use of spot symbols.

(5) Evaluate the validity and regional consistency of application of map unit concepts:
- (i) Analyze the soil-landscape model: Do the same mapping units occur in the same or similar geology, landforms, and parent materials?
- (ii) Are lines placed accurately on the map? Do crisp boundaries exist where these placements may be evaluated, e.g., the upland and flood plain interface or at the edge of water features?

(6) What are the join issues between adjacent soil survey areas?

(7) What is the extent of change in land use within the survey area?

(8) Have catastrophic natural events or human activities altered the land?

(9) Review the kind and accuracy of the soil interpretations. Consider interpretive results and relation of data entries to criteria:
- (i) interpretations that were not previously included, and are currently needed, and the development of local interpretations;
- (ii) improvements that can be made by new and improved data;

(iii) changes in land use since the base photography was acquired;
(iv) the need for additional soil property or soil quality information;
(v) knowledge of soil response to different uses and management.

(10) Review and evaluate the accuracy and consistency of data that exists in NASIS.

(d) Evaluation Documentation

A written summary of the evaluation must be a component of the process to allow development of conclusions and a comparison of situations among survey areas within an MLRA. Evaluation worksheets in Exhibits 610-1 and 610-2 can be used for this purpose as needed. Modify them to accommodate local conditions.

610.04 Developing a Plan for Updating Soil Survey Information.

Actions to update soil survey information are based on the results of the formal evaluation. All update of soil survey information is planned and conducted within the context of the entire MLRA. A common approach is to focus on specific groups of soils within the MLRA and coordinate them across existing soil survey area boundaries, following natural landforms. Update of soil survey information includes soil tabular databases, soil spatial data, and documentation, such as information from soil investigations.

(a) Workload Analysis – Long-Range Plan of Operation

(1) The MLRA workload analysis – long-range plan of operation addresses all categories of soil survey work needed to bring the deficiencies identified in the evaluation to the standard defined in the MLRA region-wide memorandum of understanding. Exhibit 608-3 illustrates a sample plan for a MLRA.

(i) Prioritize deficiencies by MLRA.
(ii) Archive a record of the complete list of deficiencies in the workload analysis – long-range plan and use as a basis for formulating a project plan of operations detailing work to be accomplished over about a 2 to 5 year period.

(2) The plan should include a strategy to update soil mapping. Include a discussion of the categories that best describe the work needed to bring the soil maps to a common standard throughout the MLRA. Revisions or supplements to the soil map fit into the categories described below. Use a planimetrically correct base to join adjacent surveys. Support all revisions with a documented evaluation of the entire MLRA. Plans to update soil mapping depend on the results of the formal evaluation.

(i) Extensive revision (a detailed form of "update")

Extensive revision requires considerable fieldwork involving remapping and updating soil descriptions. Extensive revision is seldom used and available only if the survey evaluation documents that remapping a significant portion of the survey is justified. Revising the soil map for a significant portion of an existing soil survey is rarely needed. When such a revision is deemed necessary, use the same procedures as listed for an initial soil survey. A project soil survey memorandum of understanding is not required, but can be prepared if it is deemed valuable. It must be compatible with the MLRA Region-wide MOU. Approval to extensively revise must be obtained from the Director of the Soil Survey Division. Include the soil survey evaluation along with the request for approval.

(ii) Update

All other degrees of revision are included in "Update". A workload analysis – long-range plan is developed to establish update priorities within the MLRA that accommodate all or most of the parties involved (e.g., different states, agencies, and partners). A project plan of operations describing the specific work and timeline is developed to address the highest priorities that can be accomplished by the MLRA Soil Survey Office staff within about a 2 to 5 year period. See part 608.06.

- Modernize the soil map base

  Obtain a new base and compile soil delineations, symbols, and cultural features only when the soil map base is not sufficiently current to meet the needs of the survey. Digitize a new soil map and issue as needed. Purchase of a new base requires approval by the Director, Soil Survey Division. Send requests to the Director, National Soil Survey Center, for coordination. This action is normal maintenance of the soil survey. The status of soil survey continues as published in the Soil Survey Schedule. A project soil survey memorandum of understanding is not required.

- Supplemental soil mapping

  Supplemental mapping is another soil data layer that is made for a specific purpose. It provides more detailed soil information than is contained in the official soil survey for an area of limited extent, such as a university experiment station farm. Document the objective, purpose, scale, and expected use of the information. Map the area and record supporting data, such as the soil legend, map unit descriptions, soil properties and qualities, and interpretations. Supplemental information is issued as needed on a local basis. These actions, however, do not constitute a change to official soil survey information. The status of soil survey continues as published in the Soil Survey Schedule. A memorandum of understanding is not required.

(3) Specify which method will be used to manage the MLRA soil survey legend (see part 610.07).

(b) Project Plan of Operations (2 to 5 year plan)

(1) Identify specific priorities within the MLRA that can be accomplished within about a 2 to 5 year period. Part 608 contains additional information. Exhibit 608-4 provides an example.

(2) Each state and their partners (at state work planning conferences) will prioritize update projects needed within the next 2 to 5 year timeframe.

(3) The MO will collect these priorities from each state.

(4) An MLRA-SSO technical advisory group will review the priorities from the states and work to develop a consensus recommendation for a 2 to 5 year project plan of operations. The group consists of:

(i) the MO Leader and the State Soil Scientist from each state affiliated with that particular MLRA-SSO; and

(ii) soil survey program managers from partner agencies.

(5) Present the plan to the MO Board of Directors (BOD) for concurrence of decisions as necessary.

(c) Annual Plan of Operations

(1) Annual plans of operation should also be developed to guide and provide specific focus to staff as the 2 to 5 year projects are being implemented. Part 608 contains additional information.

(2) Annual plan of operations will be put in place by MOs and MLRA SSOs subsequent to the development of the two to five year plan. The list of needs and priorities may change with time (Farm Bill priorities, deficiencies identified as other projects are being performed, cost share opportunities, etc.) and flexibility should be maintained to make adjustments within this process.

610.05 NASIS Legend Management for Updates.

(a) Purpose

Managing legends in NASIS contributes to the overall goal of providing a seamless, high quality soil survey geographic database (SSURGO) for the nation. The MLRA is the geographic area chosen to manage, update, and upgrade soil survey information. Subsets of soil survey information – a traditional non-MLRA Soil Survey Area, a Common Resource Area, a National Forest, or a watershed – can be clipped out using a GIS, and the associated attribute data could be selected using the legend area overlap NASIS query. The MLRA soil survey areas are designed to facilitate the update of soil survey information, either by map unit, groups of map units, series and groups of series, landform, and geographic area or other areas not coincident with the traditional soil survey areas. The soil survey legend is a tool for the MLRA Soil Survey Office Leader to evaluate, manage, correlate, update, and upgrade the soil survey information within the geographic area of responsibility.

The "Non-MLRA Soil Survey Area" legends are designated as the Official Legend for the traditionally defined soil survey areas. These legends are posted to the Soil Data Mart by the State Soil Scientist. It is not necessary to create additional copies of the "Non-MLRA Soil Survey Area" legend for a survey area that is under update. The map units and their documentation, correlation history, and progress are to be maintained in the one "official" legend. The Soil Data Warehouse is the archive database for older versions of the legends and associated tabular and spatial data.

(b) Methods for Managing MLRA Legends

There are two methods to create, manage, and update MLRA legends in NASIS. Specify which method will be used in the workload analysis – long-range plan.

(1) The preferred method is to manage all map units for the MLRA within the official legend designated with the Area Type Name of "Non-MLRA Soil Survey Area". Queries and reports are available in NASIS to efficiently manage legends using this method. Less time and resources are needed to manage the MLRA updates because this system is already in place and no further legend development is necessary. The map units within the MLRA are managed using the Legend Area Overlap and Map Unit Area Overlap tables. The Legend Area Overlap table lists the MLRA(s) that are within the "Non-MLRA Soil Survey Area." The Map Unit Area Overlap table is populated with the map units occurring within the given MLRA. If new MLRAs are established or boundaries of MLRAs have changed, the map units contained within the overlap tables should be reviewed and updated.

(2) An alternative method is to develop an MLRA legend with the Area Type Name of "MLRA Soil Survey Area". This legend can serve as a tool for the MLRA soil survey leader to track and store the map units within the entire MLRA. Using this legend, the Legend Area Overlap table contains a list of all "County or Parish" and "Non-MLRA Soil Survey Areas" within the MLRA. The Map Unit Area Overlap table is used to populate the associated MLRA map units for the given county or parish. Each unique MLRA map unit name must contain the correlation records for each of the associated official survey map units. This step is required to assure

proper correlation of map units in order to create a conversion legend. A separate MLRA legend allows update work to progress without affecting certified "Non-MLRA Soil Survey Area" legends.

610.06 Managing Soil Spatial and Tabular Databases.

Soil survey attribute data, and to the extent possible, all other soil survey information (maps, interpretations, and metadata) are maintained in a central, sole-source repository (Soil Data Warehouse). These data are accessible to customers electronically through the Web Soil Survey and the Soil Data Mart, which are dynamic soil survey information delivery systems. SSURGO spatial, tabular, and metadata can also be obtained from the Geospatial Data Gateway. New and updated soil survey information, when placed into the Soil Data Warehouse, provides customers with the latest soil survey information. Procedures to enhance the information in the Soil Data Warehouse are part of the normal update of soil survey information.

Incorrect entries, obsolete terms, and null data are common deficiencies in the Soil Data Warehouse. Data searches of these errors satisfy the need for an evaluation and change over the extent of the mapping unit and additional evaluation actions are not needed. Entries or corrections to data entries can be made anytime that the errors are discovered, including changes to taxonomic soil classification. Changes that affect the legend, such as component names used in the map unit name, are proposed by the MLRA-SSO and approved by the MO. Correlation decisions should be recorded in NASIS or, if not yet SSURGO-certified, with an amendment to the correlation document as appropriate. The MO assures the quality of all new and revised soil survey data in the region.

(a) Permissions to Edit Data

Entering new data and revising existing data may be done by MO staff, State Office staff, Soil Survey Office staff, or other appropriate individuals, as agreed-to by the State Soil Scientist and MLRA Regional Office Leader. NCSS partner agencies may be the steward for soil survey data on federal lands. The State Soil Scientist may assign competent, trained individuals within the state to edit data in NASIS as necessary to carry out program responsibilities. The MO is responsible for assigning editing permissions in NASIS and assuring that individuals with editing privileges are properly trained. Allowing data to be edited at multiple levels in the organization facilitates improvements to the soil data and timely distribution to the public through the Soil Data Mart and Web Soil Survey.

(b) Scheduled Updates to the Data

At least annually, and as frequently as needed to meet NRCS or cooperator needs, schedule updates to the information in NASIS and export to the Soil Data Warehouse for all soil survey areas. Soil databases are maintained by the individual non-MLRA soil survey area currently defined within NASIS.

(c) Managing Spatial Data

Use various GIS and database software to coordinate across multiple non-MLRA soil survey areas within the MLRA. Use a planimetrically correct base to join adjacent surveys. Support all revisions with a documented evaluation of the entire MLRA.

(1) Assemble a spatial dataset for the MLRA soil survey area using an acceptable coordinate system, quality standards, portable format, and scale for all geographic areas for which the MLRA Soil Survey Office is responsible.

(2) Any part of the MLRA soil survey area-wide dataset (as defined by an area-of-interest) can be extracted/exported for evaluation, editing, and/or updating.

(3) When work is completed, the revised spatial dataset from the area-of-interest is checked-in/merged with the MLRA soil survey area-wide dataset for evaluation by the MLRA Soil Survey Office Leader.

(4) If the MLRA Soil Survey Office Leader accepts the edits/updates, the revised dataset is incorporated into the MLRA soil survey area-wide dataset.

(5) The MLRA Regional Office performs a quality assurance review of the revised spatial data.

(6) The State Soil Scientist determines if the revisions warrant placement into the Soil Data Warehouse.

(7) Based on the date and person making edits to the soils layer, the revised polygons are extracted and placed into the Soil Data Warehouse. Currently, this step requires clipping and submitting the non-MLRA soil survey area to the Soil Data Warehouse.

(8) A pending modification to the current procedure will accept incremental updates at the polygon level. It is expected that few surveys will need to be reposted in their entirety in this MLRA soil survey area environment. Historical record keeping is greatly reduced and processing more efficient.

(9) Metadata will track changes to this much smaller geographic area, potentially at the polygon level in a revised Soil Data Warehouse environment.

(10) The State Soil Scientist (or designee) notifies the appropriate area and field offices, and affected partner agencies of major revisions to the database, particularly if reclassification and update mapping affect USDA program implementation, such as changes to the hydric soils, highly erodible soils, and prime farmland lists.

(11) Attribute data (NASIS) needs to be current and included to successfully post the modifications.

(d) Managing Tabular Data in NASIS

Record database changes in NASIS update of soil survey information includes populating and revising soil attribute databases based on documentation, such as information from soil investigations, including benchmark soils. Investigations are discussed in part 631 and benchmark soils in part 630.

610.07 Certification of Soils Data. (Reserved)

Exhibit 610-1 Sample Map Unit Evaluation Worksheet.

(Used for the evaluation of each map unit, the evaluation of the taxa used in the map unit name, and the evaluation of individual delineations of the map unit.)

MLRA ______________________________

Soil Survey Area Identification: Name ____________________ Number __________

Map Unit Symbol ______________________________

Part A. Evaluation of the map unit in the database.

Map unit name as published ______________________________

Probable map unit name if recorrelated ______________________________

____

Do map unit names correspond with current NCSS and editorial standards? __________

Acres of the map unit correlated in the survey area ________, percent of the survey area ________

Is the unit adequately described? ________. If not, what is inadequate? __________

Does the map unit design meet current user needs within the MLRA? __________

Are limiting dissimilar soils named as minor map unit components? __________

Is the amount consistent with NSSH guidelines? ______________________________

Major uses of the map unit at the time it was correlated ______________________________

now ______________________________

Comments: ______________________________

Are soil properties consistent with the current land use? ______________________________

Are soil property entries to the NASIS database complete? ______________________________

Part B. Evaluation of the map unit components used to name the map unit.

Series, family, or higher category, name and classification or miscellaneous area name in the database

____

Probable component name and/or classification if updated ______________________________

____

Do miscellaneous area names correspond with the approved list of miscellaneous areas? __________

Probable component name if updated ______________________________

Are component names written in title case (e.g., Jonus)? ______________________________

Are phase criteria properly entered in the phase? ______________________________

Can the soil component be classified as presently described? ______. If no, why not? __________

____

Depth of typifying pedon _______inches. Does the series (taxa), as described, overlap with other series (taxa) ______? If yes, how so? ______________________________

Does the typical pedon used represent the map unit component? ______________________

Is there lab data for the series (taxa)? ________ If yes, is it adequate? ______________________

Is the representative pedon within the RIC of the OSD? ________ If not, why not? ______________

____

Is the series consistent with parent material? __________ With geomorphic landform? __________

With geographic setting? ______________MLRA? ______________________

Comments: ____

Part C: Evaluation of the map unit delineations.

Do soil boundary lines fit major landform breaks? ____________

Do lines correctly separate map units in the soil landform? ________

Is there a need to delineate dissimilar soils? ______________

Are dissimilar soils consistent with the map unit description? ______

Is the intensity of mapping suitable for the land use? __________

Does the series concept, as correlated, fit mapped areas? ________

How was the mapping evaluated?______________________________________

User comments ________ transects ________ field notes ________ descriptions ____________

remapping ________ or road checking line placement ________

Is there an exact join with surrounding surveys? ____________

Comments: ____

Is soil mapping consistently applied to landscapes across the major land resource area? ________

Does the use of features and symbols reflect current definitions and use standards on the Feature and Symbol Legend for Soil Survey, NRCS-SOI-37A 5/2001? ______________________________

Part D. Summary.

Will this map unit require extensive revision (remapping)? ________

If no, what are the main concern(s) in updating this map unit?

The information about map unit composition and/or soil patterns is inadequate.

The map units are improperly named at the series or higher category of soil taxonomy.

The map units have incorrect phase criteria.

The map units use unapproved names for miscellaneous areas.

The map unit names do not meet current editorial standards.

Other. Please specify.

Exhibit 610-2 Sample Soil Survey Evaluation Worksheet.

Soil Survey Evaluation Worksheet
For

______________________________ Area

I. General Information

Acreage: Private ____________ Public ____________

State ____________
USFS ____________
BLM ____________
Indian ____________
NPS ____________
DOD ____________
FWS ____________
BIA ____________
Other ____________

Date/dates: Published ____________ Correlated ______

Base map: Scale ____________ Kind ____________

Field work: Began ____________ Completed ________

Land Use, in acres from NRI:
Cropland ____________
Pastureland ________
Rangeland ________
Forest land ________
Urban land ________
Wildlife land ________
Other ____________

List the extent in acres of important land use changes since the existing soil survey was mapped:
____________acres from____________________to ____
____________acres from____________________to ____
____________acres from____________________to ____
____________acres from____________________to ____

II Quality of the Existing Soil Survey Information

A. Soil maps
On a separate attachment, list the symbols and the acreage of those map units that require extensive revision. Briefly explain how the determinations were made and what corrective actions are needed. The map units generally have one or more of the following problems.

1. The soil lines do not delineate landform segments, which can be identified on the ground and on the maps.

2. Delineations of the same map unit do not consistently identify the same landform segment.

3. Additional delineations of landform segments can be made within the map unit and are needed by users. For example, the existing map unit design may be inadequate for current needs.

B. Map unit names and descriptions
On a separate attachment, using the categories below, list the names and acreages of map units that do not need remapping but require update or re-correlation to meet the standards for naming and interpretation.

1. The information about map unit composition and/or soil patterns is inadequate.

2. The map units are improperly named at the series or higher category of soil taxonomy.

3. The map units have incorrect phase criteria.

4. The map units use unapproved names for miscellaneous areas

5. The map unit names do not meet editorial standards.

6. Other (explain).

C. Interpretations
On a separate attachment, list those map units that do not need remapping or recorrelation but require additional soil property information to provide updated or new interpretations. Briefly describe how the determinations were made and what corrective actions are needed.

III. Plans to Improve the Soil Survey

Describe the project area, MLRA, multi-county, or regional project

How will the soil maps be digitized?

What is the new base map? Kind ______________________

Scale ______________________

What additional soil data do users need?

____
____
____
____
____

What additional interpretations do users need?

____
____
____
____
____

Briefly describe the investigative and laboratory support needed to provide the new data and interpretations.

Briefly, describe how this survey will be improved by the update.

Briefly describe any publication plans in addition to the Web Soil Survey.

IV. Staffing and Budgeting Needs

Estimate the staff years to complete:

Soil remapping__________________staff years

Update map unit names___________staff years

Interpretations_________________staff years

Investigations__________________staff years

Descriptions, transects, etc________staff years

Publication development_________staff years

Database population____________staff years

Others (soils)__________________staff years

Total (soils)___________________staff years

Estimate the kind and amount of support needed from other disciplines.

Estimate the kind and amount of additional support available for the update.

Federal

State

Local

Part 614 - APPLYING SOIL TAXONOMY

CONTENTS

614.00 Definition and Purpose.

The national system of soil classification identifies sets of soil properties and groups them in taxonomic classes. The system is dynamic and amended as needed. The purpose of soil classification is to order, name, organize, understand, remember, transfer, and use information about soils.

614.01 Policy and Responsibilities.

(a) The Natural Resources Conservation Service (NRCS) maintains and provides leadership for amending *Soil Taxonomy* and for maintaining the soil series classification files. All soil surveys within the National Cooperative Soil Survey must utilize Soil Taxonomy.

(b) The MLRA office is responsible for:

- maintaining accurate and current descriptions of soil series,
- approving changes to the type location of soil series,
- soil series classification and the official soil series description files,
- approving the names of soil series, and
- approving all official series descriptions.

(c) All users are responsible for reviewing and recommending the disposition of proposals to amend the soil classification system.

(d) The National Soil Survey Center is responsible for:

- leadership for maintaining and amending *Soil Taxonomy* and for part 615 NSSH: Amendments to *Soil Taxonomy,*
- maintaining the soil series classification and official soil series description file system, and
- maintaining standards on the use of soil classification within soil survey.

614.02 National Soil Classification System.

The national soil classification system has two parts:

(a) The first part is *Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys*, second edition, Agriculture Handbook No. 436, referred to as *Soil Taxonomy 2nd edition,* latest revision (http://soils.usda.gov/technical/classification/taxonomy/). This part provides definitions and nomenclature for classifying soils. The National Cooperative Soil Survey (NCSS) adopted this system in January 1965. The amendments to the system are in the NSSH part 615 until placed into the revised edition of *Keys to Soil Taxonomy* and the Web version of *Soil Taxonomy.*

(b) The second part consists of the official soil series descriptions. The Soil Survey Division maintains the official soil series description file (http://soils.usda.gov/technical/classification/scfile/index.html) and the soil series classification file (http://soils.usda.gov/technical/classification/scfile/index.html). These files list the classification of established, tentative, and inactive soil series of the United States, Puerto Rico, the Pacific Basin, and the U.S. Virgin Islands. The official soil series description file is the official reference to soil series descriptions. The soil series classification file is the official source for the classification of the soil series. Both the official soil series description file and the soil series classification file are accessible by computer.

614.03 Use of the National Soil Classification System in Soil Surveys.

(a) Soil surveys use *Soil Taxonomy* to provide:

- a connotative naming system that enables those users familiar with the nomenclature to remember selected properties of soils,

- a means for understanding the relationships among soils within a given area and in different areas,
- a means of communicating concepts of soils and soil properties,
- a means of projecting experience with soils from one area to another, and
- names that can be used as reference terms to identify soil map unit components.

Chapter 5, of *Soil Taxonomy 2nd edition* provides general information on the application of soil classification to soil maps of various scales.

(b) The names of soil taxa are reference terms for naming soil components of map unit in most soil surveys. Soil taxa are classes at any categorical level in the multi-categorical system of Soil Taxonomy. The name that is used is generally from a taxon of the lowest category that identifies the dominant kind or kinds of soil. Because soil taxa names can have several meanings, the names must be clearly understood. Page 124 of *Soil Taxonomy* provides more information. Even though names of one or more taxonomic classes identify map units, the map units are not the same as soil taxa. If the fixed limits of soil taxa are superimposed on the pattern of soils in nature, the limits of taxonomic classes rarely, if ever, coincide precisely with mappable areas. In addition to the named component or components, a map unit contains components of minor extent that are inclusions of other soils that may be similar or dissimilar to the named soil. Part 627 of this handbook discusses major and minor map unit components, inclusions, and dissimilar and similar soils.

(c) Distinguish a map unit name from a soil taxon name by adding one or more phase terms to the soil taxon reference name. For example, Gamma is a soil taxon; Gamma silt loam, saline, 0 to 2 percent slopes, is a map unit name. Part 627 of this handbook provides direction to naming map units. Chapter 5 of *Soil Taxonomy* and Chapter 2 of the *Soil Survey Manual* provide additional discussion of the relationship between soil taxa and map units and the naming of map units.

614.04 Soil Taxonomy Committees, Work Groups, and Referees.

(a) Regional Soil Taxonomy Committees. Each group of states within the experiment station region has a soil taxonomy committee (or other standards-related committee) as part of the Regional Cooperative Soil Survey Conference. The membership and operational procedures of the committee should be described in the regional conference by-laws. These committees work on standards-related issues that are identified as being important within the region, and also review proposed amendments that are referred to them from time to time by the National Leader for Soil Classification and Standards..

(b) National Soil Taxonomy Committee. The National NCSS Conference has a Standing Committee on Standards that includes some members from the regional committees as well as other members appointed by the Conference Steering Committee. The membership and operational procedures of the committee is described in the national NCSS conference by-laws. This committee works on standards-related issues that are identified by the Conference Steering Committee as being important, considers business items refered to it by the regional committees, and also reviews proposed amendments that are referred to them from time to time by the National Leader for Soil Classification and Standards

(c) National ad hoc work groups. The Director, Soil Survey Division, appoints work groups as needed. They review reports from regional soil taxonomy committees and recommend additional study or implementation of proposed amendments. Membership includes representatives of State and Federal agencies and may include international representatives. The groups have:

- a chairperson, usually a member of the National Soil Survey Center staff, and
- additional members, depending upon the nature of the recommended changes and the expertise needed.

(d) International committees. The Director, Soil Survey Division, establishes international committees if major national and international users of *Soil Taxonomy* identify a need for major additions or changes in the soil classification system. The Director appoints a chairperson. Membership is open to any user of *Soil Taxonomy* who chooses to participate and usually includes representatives of State and Federal agencies as well as international cooperators.

(d) Referees. The Director may request referees to prepare position papers on proposed amendments. The referee requests, as needed, a review by peers and assumes the responsibility for decisions regarding the proposal.

614.05 Procedures for Amending Soil Taxonomy.

(a) Submitting proposed amendments.

(1) Proposals may be made by anyone using *Soil Taxonomy* from within or outside the United States. Submit proposals that originate in the United States to the National Leader, Soil Classification & Standards or to the appropriate regional soil taxonomy committee chair.

(2) Submit proposals that originate outside the United States to the appropriate international committee or to the National Leader, Soil Classification & Standards, at the National Soil Survey Center, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, Nebraska, 68508-3866.

(b) Documenting proposed amendments.

(1) Above the family level. The minimum supporting evidence for all proposed classes must include pedon descriptions, the impact on interpretations, an estimate of geographical extent, and certain laboratory data. The laboratory data must be on at least the critical parts of diagnostic horizons in the proposed new class if the limits between the proposed class and the other recognized classes cannot be adequately identified using field criteria alone.

(2) New family criteria. The minimum supporting evidence includes about 10 pedon descriptions or a description of a proposed soil series and the expected impact on interpretations for the intended use. Submit laboratory data on at least the critical parts of the proposed new class if the limits between the proposed class and the other recognized classes cannot be adequately identified using field criteria alone.

(c) Evaluating proposed amendments.

(1) The National Leader, Soil Classification & Standards, at the National Soil Survey Center circulates the proposed amendment to all cooperators for review. Review and comment is welcome from any interested cooperators. Those who are current members of the regional taxonomy committees have a special obligation to review and comment on proposals. Cooperators recommend (i) approval without change, (ii) approval with change, or (iii) rejection. Recommendations to change or reject the proposal are documented. The National Leader, Soil Classification & Standards, reviews the recommendations and either makes a decision to return the proposal to the originator with reasons for the rejection or includes the proposal in a part 615 NSSH issue. The Deputy Chief for Soil Survey and Resource Assessments signs the cover letter for the distribution of the issue and thus also gives final official approval for the changes.

(2) The National Leader, Soil Classification & Standards, evaluates all proposals from the international committees and other proposals that originate outside the United States, arranges for a review of these proposals by cooperators or work groups, and makes disposition of the proposals.

(d) Distributing amendments.

(1) The publication of the amendments constitutes final approval. NRCS directives issue amendments that become additions to part 615 NSSH: Amendments to Soil Taxonomy. Updates of *Keys to Soil Taxonomy* include these amendments. All soil scientists of the NCSS and to other soil scientists, both national and international receive copies of amendments.

(2) The originator receives proposed amendments that are rejected along with recommendations for disposition to.

614.06 The Soil Series.

The soil series is the lowest category of the national soil classification system. The name of a soil series or the phase of a soil series is the most common reference term used in soil map unit names. The name of a soil series is also the most common reference term used as a soil map unit component. The purpose of the soil series category is closely allied to the interpretive uses of the system, though map unit components provide the interpretive applications within soil survey for most detailed purposes. Soil series are the most homogeneous classes in the system of taxonomy.

Chapter 21, pages 832-836, of *Soil Taxonomy* provides guidance for series differentiae within a family.

(a) Establishing norms and class limits for soil series.

(1) In developing or revising soil series concepts, systematic procedures are essential. They reduce the possibility of recognizing more soil series than are necessary to organize and present existing knowledge about soil behavior. The distinctions between one soil series and its competitors must be large enough to be consistently recognized and to be recorded clearly. Clearly differentiate each soil series from all other soil series. Simplify this differentiation by using the systematic procedure described in this section.

(2) Assemble and study all available information on morphology, composition, position on the landscape, and geographic distribution of the soils being considered. Compare the available information with the concepts of existing soil series, and evaluate possible concepts for new soil series. Refine soil characteristics that define higher categories of soil taxonomy to differentiate one soil series from another. These characteristics reflect the kind and sequence of horizons that can be observed, or they associate with characteristics that are observable and that can be consistently measured. Only use those characteristics that are observed or measured within the soil series control section to differentiate soil series. Chapter 21 of *Soil Taxonomy* provides more information on the series control section. A significant soil characteristic is one that has genetic implication, such as the nature or arrangement of horizons or the absence of horizons, or one that has an influence on use and management, such as percent of gravel or reaction. Exercise judgment in the selection and weighing of soil characteristics used to set apart soil series. Chapter 21 of *Soil Taxonomy* gives a further discussion of soil series and their differentiae.

(3) Competing soil series are those that are in the same family as the soil series under study. Changing the concept of one soil series likely stimulates modification to the concepts of other soil series in the family.

(4) When proposing a new series, conceptualize a model of it. Develop a model with a specific norm and range in characteristics for the proposed soil series description. Some of the characteristics of the new series will overlap the characteristics of an existing series; however, the range for differentiating characteristics cannot overlap with that of an existing soil series in the same family. Limits of the range in soil characteristics for the proposed soil series may be as wide as those permitted in the family to which it belongs. Generally keep the range in differentiating soil characteristics of the soil series narrower than that for the span of the family. The permissible ranges should not be defined too narrow for precise and consistent identification. They must be practical.

(5) Select a pedon that is typical for the soil series concept. The typical pedon is a reference specimen that illustrates the central concept for the soil series. This pedon, along with other very similar pedons, forms the model for the soil series class. Thus, the selection of a typical pedon is a very important process and is done with great care. Base it on the arrayed data on morphology, composition, and geographic distribution. No pedon is likely to be central for all ranges, but the representative pedon should lie reasonably near the center of the ranges for most physical and chemical properties and for the geographic distribution. If the pedon selected to typify a soil series has one or more properties unusual for the soil series class, record the properties as part of the range of characteristics and note them in the "Remarks" section of the description.

(6) After selecting the typical pedon, define the permissible ranges in soil characteristics. Use the arrayed information on morphology and composition of the soils, especially the profile descriptions, field notes, and laboratory analyses.

(7) Only part of the set of observed properties define the classification of any soil, but consider all properties when defining the soil series. Not all observable soil properties are necessarily definitive for a soil series class. The definitive properties that set a soil series apart from similar competing soil series are essential. Emphasize these properties in the statement of the range of characteristics. Also describe the ranges in significant properties that do not differentiate between the soil series being described and its competing soil series.

(8) Next, test the soil series concept. Check the norm and ranges in characteristics against the class limits for the family to which the soil series belongs. Do not cross the limits of the family with the ranges specified for the soil series. The distinctions in definitive characteristics between the norms for the proposed soil series and the norms for competing soil series must be clearly greater than what may be normal errors of observation or be based on laboratory data and geomorphic or geographic information. Do not overlap ranges in differentiating characteristics.

(9) Differences in a single characteristic seldom set apart soil series. Use the distinctions in several characteristics to separate soil series. Some may have greater influence than others. Justify a new soil series if the differences in morphology and composition are clearly greater than what are normal errors of observation and affect use and management. It is hard to decide whether or not to propose a new soil series when two or more properties of the soils to be classified are outside but near the limits of an existing soil series. Propose new soil series if the soils differ in characteristics that have practical significance to use and management.

(b) Normal errors of observation. As a general guide, a new soil series differs appreciably in either morphology or composition, or both, from already defined soil series. Differences in relevant characteristics must be larger than what may be normal errors of observation or estimates. The following paragraphs give examples of allowed normal errors of observation and tolerance. Soils within these tolerances do not need a new series, nor do they need to be named as taxadjuncts.

(1) Identification of soil color in the field is subject to errors because of (i) changes in the quality of light and in soil moisture, (ii) differences in the visual acuity and skill of individuals, and (iii) limitations in the standards used to determine color. Chapter 3 of the *Soil Survey Manual* provides a discussion of soil color. Field observations of soil color are at different times of the day and have differing soil moisture contents. These variables could result in differences as large as a full interval between chips in the Munsell color system. The differences in identification of soil color resulting from one person looking at the same specimen at different times and under different conditions or from a group of individuals looking at the same specimen together are an example of normal errors of observation. Optimum field conditions allow soil color to be matched to within one-half interval between chips on the color chart. The normal range of difference between careful observations is plus or minus a half interval between chips of the same hue or between chips of the same value and chroma on adjacent hues. Color distinctions, if definitive, between the soils of two soil series, must be greater than this normal range.

(2) Field estimates of textures are commonly within plus or minus one-half class of the actual texture, though errors by highly skilled individuals are smaller. To set apart soil series that are based in part on differences in texture, use distinctions that are greater than the probable error of field estimates or use laboratory data and geomorphic or geographic information. This rule applies to the entire soil series control section and any of its parts. Not all differences among soil series are obvious. The limit between fine-loamy and fine particle-size classes is a clay content of 35 percent. The experienced mapper has little difficulty in distinguishing between 30 percent and 40 percent clay. Only the laboratory can consistently distinguish between 34 percent and 36 percent. If this is the only difference, the distinction is not important for most uses of the soil map. Name the delineation for either of the two soil series that have a common conceptual boundary at 35 percent clay. Differences that are no greater than the normal errors of observation cause many needless decisions, even for an experienced mapper. If the estimate of the properties varies by these normal errors, the similar inclusions that result do not seriously affect the use of the map if the map units are defined to allow for the variation.

(e) Proposing and naming a soil series.

(1) Soil scientists in the National Cooperative Soil Survey write and complete descriptions of new soil series and their accompanying estimated properties. Part 627.08(e)(1) contains documentation requirements.

(2) The soil series classification (SC) file contains a complete list of active and inactive soil series. The soil series classification file provides the official classification for all soil series in the official soil series description file (OSD). When naming a proposed series, give preference to the names of geographic places as a source of possible names. Avoid the following kinds of names:

- names consisting of very long words or of two words;
- bizarre, discriminatory, comical, and vulgar words;
- geological terms, such as the names of rocks, minerals, landforms, and the formations of a locality;
- names of animals and birds;
- given names of persons, unless the name is a known geographic location;
- copyrighted names and registered trademarks; and
- names essentially identical in pronunciation or similar in spelling to a name already in use.

Coin names if sufficient names of geographic places do not exist in a survey area or in the nearby area. Geographic place names must also avoid all restrictions listed above. Coined names must be consistent with American usage and free from the restrictions listed above.

(3) After review of the proposed soil series description within the MLRA office region, the MLRA office approves the name and reserves the name by entering the name and classification into the soil series classification (SC) file. The soil series description is identified as tentative. The MLRA office enters the soil series description into the official soil series description (OSD) file, where it is available for adjoining MLRA offices and cooperators to review and comment. A notification and request for comments is sent to

adjoining MLRA offices and to all other MLRA offices that have soil series in the same family as the proposed series.

(4) The MLRA office evaluates any comments and prepares a revision of the soil series description. The revised description is transmitted to the official soil series description file. If the decision is made not to use the series, remove the tentative soil series from the soil series classification (SC) file. This will cause the tentative soil series description in the official soil series description (OSD) file to move to an inaccessible file.

(5) The MLRA office resolves disagreements on concepts of soil series. They assemble and evaluate available evidence on the points in question, and, if necessary, request additional information about the soils under consideration from one or more MLRA regions. If the soil series is in dispute or if the questions about the soil series concept are of considerable importance, a joint field study may be necessary. After the differences have been resolved, the MLRA office updates the soil series description in the official soil series description file.

(f) Revising official soil series descriptions.

(1) Soil scientists must revise soil series descriptions if one or more of the following conditions exists:

- change in the concept of the soil series, including the range in characteristics;
- change in the classification of the soil series; and
- change in the type location of the soil series.

(2) Any soil scientist in the NCSS can write revisions of soil series descriptions. Submit these descriptions to the MLRA office assigned to the type location for the series. Base the revision on pedon descriptions, laboratory data, and other available sources of information about the soils that represent the series.

(3) If the soil series classification or type location is changed, the MLRA office reviews these changes within MLRA office region and with other MLRA office regions in which the soil series or competing series are known or expected to occur. After critical review, reviewing scientists return comments to the originating MLRA office. The MLRA office soil scientist evaluates the comments and makes the necessary changes in the revised description of the soil series. The MLRA office updates the classification of the soil series in the soil series classification file, if necessary, and then transmits the revised description to the official soil series description file.

(g) Inactivating an established soil series. The MLRA office places established soil series on the inactive list when appropriate. Support the decision to inactive a soil series with documentation as to why the soil series should be made inactive and include a recommendation for the disposition of the soils that have been classified as the inactive series. Before placing a soil series on the inactive list, the MLRA office sends a memorandum of intentions and supporting reasons to affected MLRA offices. The MLRA office notifies other disciplines and cooperators who may use the series name in databases and publications. Allow forty-five days for filing objections to the recommendation. If the MLRA office determines that the soil series should be made inactive, they notify the affected regions. The memorandum includes the reclassification to the appropriate soil series or to a taxon of a higher category of all pedons in the inactive series that have been sampled and analyzed by the NRCS, cooperating universities, highway departments, or other laboratories. List inactive soil series in the soil series classification file.

(h) Reactivating an inactive soil series name. Do not reuse the name of a soil series that is placed on the inactive list unless the series concept is the same as in the previous description. If an MLRA office wants to reactivate a soil series name, they follow the procedure that is used to propose a soil. Make a notation under "Remarks" that the soil series name is being reactivated.

(i) Dropping a tentative soil series. Drop a tentative soil series from the soil series classification list if it duplicates an already recognized series.

(1) If multiple MLRA offices use the soil series, the MLRA office with the series type location requests concurrence from user MLRA offices to drop the series. Upon concurrence, the MLRA office notifies the users that the series is dropped. The notification includes a statement of reasons for dropping the series. Note the name of the dropped series in the correlation document of the soil survey area that has the type location.

(2) If only the originating MLRA office is using a soil series listed as tentative, drop the series by listing it as dropped in the correlation document of the survey area that has the type location.

(3) Remove the name and record from the soil series classification file, this causes the description in the official soil series description file to move to an inaccessible file. Do not list a tentative soil series as inactive.

(j) Transferring responsibility for a soil series and changing the type location. Approval for transfer of the responsibility for a soil series and change of type location is as follows:

(1) The MLRA office approves changes within the MLRA office region.

(2) Mutual consent of the MLRA offices allows transfers between MLRA office regions.

All transfers of a soil series responsibility and change of type location require a series description using the new type location. The MLRA office enters the new description into the database.

(k) Establishing a soil series. A soil series is established when it is used in the correlation of a survey area and the correlation document is approved and signed by the MLRA office. The correlation document contains a list of the soil series that are established by that correlation. If a soil series is established by a correlation, the responsible MLRA office changes the status of the series in the official soil series description file and soil series classification file from "tentative" to "established" and also changes the heading "**SERIES PROPOSED**" to "**SERIES ESTABLISHED**". The MLRA office also enters in the official soil series file the year that the soil series is established and the name of the survey area in which it is established. The MLRA office transmits the updated description to the official soil series description file and the soil series classification file. If a tentative soil series is not used and established in correlation document the survey area in which it was proposed and no other potential use is pending, remove the soil series from the soil series classification file.

(l) Official soil series descriptions.

(1) "Official soil series description" is a term applied to the description approved by the MLRA offices, which defines a specific series in the United States. The description follows a prescribed format. Revise an official soil series description if more information about the soils in the series is available or if the classification of the series changes because of revisions to the national system of soil classification. All soil scientists working in the NCSS must be familiar with the requirements for adequate soil series descriptions. The *Soil Survey Manual* and Chapter 21 of *Soil Taxonomy* discuss the concept of the soil series and requirements for descriptions. Field descriptions and official soil series descriptions will use metric units of measurement.

(2) The official soil series descriptions are descriptions of the taxa in the series category of the national system of soil classification. They mainly serve as specifications for identifying and classifying soils. Field soil scientists must have access to all the existing official soil series descriptions that are applicable to their soil survey areas and other official soil series descriptions that include soils in adjacent or similar survey areas commonly. Scientists in other disciplines, such as agronomists, horticulturists, engineers, planners, and extension specialists, also use the descriptions to learn about the properties of soils in a particular area.

(3) The format for descriptions and the order in which the major items appear are as follows:

- location line,
- status of soil series (tentative or established),
- initials of authors,
- name of soil series,
- introductory paragraph,
- taxonomic class,
- typical pedon,
- type location,
- range in characteristics,
- competing series,
- geographic setting,
- geographically associated soils,
- drainage and saturated hydraulic conductivity,
- use and vegetation,
- distribution and extent,
- MLRA office responsible,
- series proposed or series established,
- remarks on diagnostic horizons and features recognized in the pedon, and

- additional data.

Every official soil series description includes all but the "additional data" item, which is used only as needed. Exhibit 614-1 is an example of an official soil series description. Exhibit 614-2 explains the content of a soil series description.

(4) Each description must be complete and as brief as possible without omitting any essential information. It must clearly differentiate between the series being described and all other series. It states the present concept of a soil series rather than past concepts or its evolution. The description must record the soil properties that:

- define the soil series,
- distinguish it from other soil series,
- serve as the basis for the placement of that soil series in the soil family, and
- provide a record of the soil properties needed to prepare soil interpretations.

(5) In the competing series paragraph, give differentiae used to separate other soils in the same family in terms of soil properties, diagnostic horizons, or features.

(6) Use the standard terminology that is defined in the *Soil Survey Manual* as appropriate. If applicable, use terms defined in *Soil Taxonomy*. The rule for the use of standard terms applies to all parts of soil series descriptions but is especially important for descriptions of individual horizons. Some soil descriptions need to use some terms that are not defined in the *Soil Survey Manual* or *Soil Taxonomy*. Use such terms in their ordinary, standard, dictionary sense.

Exhibit 614-1 Example of an Official Soil Series Description.

LOCATION GAMMA AA
Established series
Rev. AAA-BBB-CCC
5/91

GAMMA SERIES
The Gamma series consists of very deep, well drained soils that formed in marine sediments. The Gamma soils are on broad tops and side slopes of deeply dissected high marine terraces. Slope ranges from 0 to 30 percent. The mean annual temperature is 11 degrees C, and the mean annual precipitation is about 2030 mm.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, isomesic Typic Palehumults.

TYPICAL PEDON: Gamma loam, on a north-facing, convex, 4 percent slope under conifers at an elevation of 200 meters. (Colors are for moist soil unless otherwise noted. When described on March 13, 1991, the soil was moist throughout.)

Oi—0 to 5 cm; slightly decomposed needles, leaves, twigs, and other woody materials. (2 to 8 cm thick)

A1—5 to 13 cm; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; weakly smeary; many fine and very fine and few medium and coarse roots; many fine and very fine pores; very strongly acid (pH 4.9); clear smooth boundary.

A2—13 to 43 cm; very dark grayish brown (10YR 3/2) loam, dark brown (10YR 4/3) dry; weak very fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; weakly smeary; many very fine and fine and few medium and coarse roots; many very fine and fine irregular pores; very strongly acid (pH 4.5); abrupt smooth boundary. (Combined thickness of the A horizon ranges from 25 to 50 cm.)

2Bt1—43 to 80 cm; dark brown (7.5YR 3/4) loam, strong brown (7.5YR 5/6) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine and few medium and coarse roots; many very fine continuous tubular pores; few faint clay films on faces of peds; common faint clay films in pores; 10 percent gravel; very strongly acid (pH 4.9); gradual smooth boundary.

2Bt2—80 to 100 cm; reddish brown (5YR 4/4) loam, yellowish red (5YR 5/8) dry; moderate medium and coarse subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common fine and few medium and coarse roots; common very fine continuous tubular pores; common distinct clay films on faces of peds and in pores; 10 percent gravel; very strongly acid (pH 5.0); clear smooth boundary.

2Bt3—100 to 135 cm; brown (7.5YR 4/4) clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse subangular blocky structure; slightly hard, firm, moderately sticky and moderately plastic; common fine and few medium and coarse roots; many very fine continuous tubular pores; common distinct clay films on faces of peds and in pores; 10 percent gravel; very strongly acid (pH 5.0); gradual smooth boundary. (Combined thickness of the 2Bt horizon is 75 to 120 cm .)

2BC—135 to 160 cm; yellowish red (5YR 4/6) gravelly clay loam, strong brown (7.5YR 5/8) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; common fine continuous tubular pores; 20 percent gravel; very strongly acid (pH 5.0); gradual smooth boundary. (15 to 40 cm thick)

2C—160 to 200 cm; yellowish red (5YR 4/6) gravelly clay loam, reddish yellow (5YR 6/6) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine continuous tubular pores; 20 percent gravel; very strongly acid (pH 5.0).

TYPE LOCATION: Any County, Anystate; located about 750 feet south and 2,220 feet east of the northwest corner of sec. 31, T. 40 S., R. 13 W; USGS named topographic quadrangle; lat. 42 degrees 4 minutes 31 seconds N. and long. 95 degrees 17 minutes 30 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The mean annual soil temperature is 10 to 12 degrees C., the mean summer soil temperature is 12 to 14 degrees C., and the mean winter soil temperature is about 8 to 10 degrees C. The difference between the mean summer and winter temperatures ranges from 3 to 4 degrees C. The soils are usually moist, and they are dry for less than 45 consecutive days in all parts between depths of 10 to 30 cm in the four months following the summer solstice. The particle-size control section averages 25 to 35 percent clay. All horizons are very strongly acid or extremely acid. The umbric epipedon is 25 to 50 cm thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist, 3 or 4 dry, and chroma of 2 or 3 moist and dry. It is 10 to 20 percent clay, 30 percent sand, and has 0 to 10 percent gravel.

The 2Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4 moist, 4 or 5 dry, and chroma of 4 to 6 moist, 6 to 8 dry. It is gravelly loam, gravelly clay loam, loam, or clay loam. It averages 25 to 35 percent clay, 30 to 45 percent sand, and 5 to 20 percent gravel.

The 2BC horizon has hue of 7.5YR or 5YR, value of 4 to 6 moist, 5 to 8 dry, and chroma of 6 to 8 moist, and dry. It is gravelly loam, gravely clay loam, loam, or clay loam. It averages 25 to 35 percent clay, 30 to 45 percent sand, and 10 to 30 percent gravel.

The 2C horizon has hue of 7.5YR or 5YR, value of 4 to 6 moist, 6 to 8 dry, and chroma of 6 to 8 moist and dry. It is gravelly loam, gravelly clay loam, loam, or clay loam. It averages 25 to 35 percent clay, 25 to 45 percent sand, and 10 to 30 percent gravel.

COMPETING SERIES: This is the Beta series. Beta soils have less than 30 percent sand in the argillic horizon and hue of 10YR or yellower throughout the argillic horizon.

GEOGRAPHIC SETTING: The Gamma soils are on broad summits and side slopes of deeply dissected high marine terraces. Slope ranges from 0 to 30 percent. The soils formed in marine sediments. Elevations are 180 to 250 meters. The climate is humid and characterized by cool wet winters and cool moist summers with fog. Because of a strong marine influence, the diurnal and annual ranges of temperature are limited. The mean annual precipitation is 1800 to 2300 mm. The mean annual temperature is 10 to 12 degrees C. The frost-free period is 210 to 300 days. The Gamma soils are on the Griggs geomorphic surface.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Delta and Gamma soils. Delta soils have 35 to 45 percent clay in the argillic horizon and are on an adjacent higher marine terrace. Gamma soils have a cambic horizon, have an umbric epipedon that is 50 to 75 cm thick, and are on an adjacent lower marine terrace.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained, low to high runoff, moderately high saturated hydraulic conductivity.

USE AND VEGETATION: These soils are used for homesites, timber production, recreation, water supply, pasture, and wildlife habitat. Native vegetation is Sitka spruce, Douglas-fir, red alder, red elderberry, salmonberry, evergreen huckleberry, sala, western swordfern, evergreen violet, and sweetscented bedstraw.

DISTRIBUTION AND EXTENT: Pleistocene marine terraces in northwestern U.S.A.; MLRA 1. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: City, State
SERIES ESTABLISHED: Any County, Anystate, 1991.

REMARKS: Diagnostic horizons and features in this pedon include:
Umbric epipedon - from a depth of 0 to 43 cm (A1 and A2 horizons).
Argillic horizon - from a depth of 43 to 135 cm (2Bt1, 2Bt2, and 2Bt3 horizons).

ADDITIONAL DATA: Partial laboratory data from pedon 89P197, samples 89P1199-1202 from Any County, Anystate, are available from the National Soil Survey Laboratory, Lincoln, NE, 12/89.

National Cooperative Soil Survey
U.S.A.

Exhibit 614-2 Explanation and Content of a Soil Series Description.

After the introductory paragraph, the format for soil series descriptions arranges the subject matter in two main parts. The first part includes the taxonomic classification, the description of the typical pedon, the type location, the section on range in characteristics, and the section on competing series. This part and the description of the diagnostic horizons and features and the "Remarks" section defines the soil series as a class in the soil classification system insofar as the available information permits. The second part includes all the remaining sections of the soil series description. It provides additional descriptive information.

The guidelines for keying soil series descriptions are as follows:

- -- Left margin is in column 1. Right margin is in column 66.
- -- Tabs, stop codes, required hyphen codes, required backspace codes, automatic centering, and underlines are not used. The spacebar is used instead of tabs.
- -- Everything is left justified except the horizon designations, which are indented 4 spaces (to column 5), using the spacebar.
- -- Section headings are in capital letters, for example, TAXONOMIC CLASS, and TYPICAL PEDON.
- -- Depths and thickness (cm), temperature (degrees C), precipitation (mm), and elevation (m) are in metric units of measure; acreage and legal descriptions (long, lat, minutes, seconds, and NAD are preferred) are in English units. General locations can be given in feet and miles.
- -- Special symbols, subscripts, and superscripts must be expressed as words.

For example: 10° is changed to 10 degrees, CaC03 is changed to calcium carbonate, and 10% is changed to 10 percent.

--The first 8 lines and the last line of the soil series description must be standardized in order for the OSD computer program to work. All entries are left justified and start in column 1.

The line-by-line instructions are as follows:

Line 1--LOCATION GAMMA NE (This line is entered in capital letters. The first letter of the state where the soil series is located must be in column 33.)

Line 2--Blank line

Line 3--Tentative Series or Established Series

Line 4--Rev. MLD-JRC (These are the initials of the individuals who last revised the soil series.).

Line 5--7/87 (This is the month and year that the soil series draft was sent to the official series description file. The system enters this date automatically.)

Line 6--Blank line

Line 7--GAMMA SERIES (All letters are capped.)

Line 8--Blank line

Line 8 is followed by the introductory paragraph and the rest of the soil series description.

Next to last line--National Cooperative Soil Survey

Last line--U.S.A. (All letters are capped and do not have spaces in between.)

The completed description must be run through spell check.

Content of soil series description.

(a) Introductory paragraph. This paragraph carries no side heading. It briefly describes the depth, drainage, soil-forming materials, and any other significant soil features that characterize the soil series and the geographic setting. This information benefits people who refer to the official soil series descriptions but are not well acquainted with the classification system. If used in the introductory paragraph, depth refers to depth to bedrock unless some other feature that is important to plants or engineering interpretations is specified. If a restrictive feature is at some depth within the soil profile, describe it by stating "very shallow to sandstone or shale," "very deep soils that are moderately deep to gravel," or "moderately deep to rhyolite and shallow to a duripan." The temperature and precipitation are mean annual values for the soil series. Do not use the terminology in *Soil Taxonomy* in the introductory paragraph. Examples of this paragraph are:

--The Gamma series consists of deep, well drained soils on moraines, drumlins, and till plains. These soils formed in a thin layer of loess and the underlying loamy glacial till. Slope ranges from 0 to 25 percent. The mean annual precipitation is about 600 mm, and the mean annual temperature is about 8 degrees C.

--The Beta series consists of very poorly drained, organic soils in drainageways and depressions on moraines, lake plains, and outwash plains. These soils formed in highly decomposed organic material over loamy glacial and lacustrine sediments. The organic material was derived from herbaceous plants. Slope ranges from 0 to 2 percent. The mean annual precipitation is 800 mm, and the mean annual temperature is 2 degrees C.

(b) Taxonomic class. This statement gives the family classification. If the classification is questionable, explain it in the "Remarks" section.

(c) Typical pedon. Use the side heading in the description, as indicated. The soil series name and texture phase term or by the word "series" follow the side heading. Next is the aspect, shape, and percent of slope and a word or phrase, such as "forested," "pasture," "cultivated field," or other term for use or cover, that shows whether or not the soil at the site has been disturbed. Place a parenthetical statement immediately below the heading and soil name to specify the moisture state of the soil when it was described. If the soil was nearly dry in the upper 60 cm and moist below, the statement, "When described, the soil was slightly moist above a depth of 60 cm and moderately moist below is used." An example of this paragraph is:

--Gamma silt loam on a southeast-facing, concave, 3 percent slope under mixed hardwoods at an elevation of 500 meters. (Colors are for moist soil unless otherwise stated. When described on July 1, 1985, the soil was slightly moist to a depth of 60 cm and moderately moist below that depth.)

(1) Descriptions of horizons. These descriptions are in paragraph form. They ordinarily consist of three parts: (1) the horizon designation, (2) the horizon depths, and (3) the description of the horizon.

(2) Pedon described. Describe an actual pedon. The pedon chosen as the typical pedon must reflect the norm for the soil series as closely as possible. The norm is the concept or mental image of the central nucleus of pedons for the soil series. The pedon may depart in minor ways from the norm without a need for explanation. If it departs from the norm in some obvious feature, however, indicate the departure in the range of characteristics and in the "Remarks" section of the description. Describe the typical pedon in its dominant land use. Describe the pedon to a depth that is at least equal to that for the series control section. Describe the relevant characteristics of R and Cr layers.

(3) Identification of horizons. Identify horizons using the horizon designations defined in Chapter 3 of the *Soil Survey Manual* and the 9th edition of the *Keys to Soil Taxonomy*. Terms that are used for diagnostic horizons of the soil classification system do not define horizons.

(4) Depth of horizons. Give the depths to the upper and lower boundaries of horizons in centimeters and follow the corresponding horizon designations. Insert a semicolon after "cm." Use the soil surface, excluding live and fresh leaves and twigs, as a reference plane for depth and thickness measurements for all mineral and organic soil horizons.

(5) Features described for horizons. These features are as follows:

- --color (dry or moist, the most common condition),
- --texture,
- --color (dry or moist, opposite of the condition initially given),
- --mottles (dry or moist, non-wetness related),

--structure (Do not use commas to separate terms in the phrase that describes structure. Use the word "structure" only once in describing compound structure, for example, "weak coarse prismatic structure parting to moderate medium subangular blocky."),
--consistence (dry, moist, stickiness, plasticity),
--roots,
--pores,
--additional features (as in item 8 that follows),
--reaction,
--lower boundary, and
--range in thickness.

(6) Sequence for describing features. Describe the features of each horizon in the order listed to make comparisons easier among horizons and among soil series. All features may not occur in every horizon. As previously specified, describe features in standard terminology as much as possible.

(7) Color. Give descriptions of colors, including Munsell notations, for individual horizons. Describe color by using Munsell notations to the nearest color chip. All surface horizons require both moist and dry colors. Other horizons require colors for both moist and dry conditions if the information is necessary for the classification of the soil series. Record colors for both dry and moist conditions even if the information is not required for classification, if known. Give moisture conditions for individual color identifications or for the whole pedon, as previously specified. Most horizons have a dominant color that changes in value and, less commonly, in hue and chroma as the moisture content changes. The color listed first represents the moisture content that is most often observed. In arid regions this is the color of dry soil, and in humid regions it is the color of moist soil. In the description of the horizon, first record the color of the matrix or interiors of the peds; then list the color of films or coating on peds if they are different from the interiors. Identify the positions of individual colors unless they are obvious from the context. Do not use hyphens in soil color names.

(8) Additional features. List these features separately because they do not occur in all soils or horizons. They include without implying order:
--slickensides,
--durinodes,
--plinthite,
--clay films,
--concretions,
--carbonates,
--salts,
--sodium,
--smeariness,
--redoximorphic features.
--pebbles, stones, and other fragments, and
--brittleness,

If such features are not mentioned in the description of a horizon, assume them to be absent. If these features are described, give the size, the color (if appropriate), the kinds, and numbers of concretions, stones, and pebbles; the distinctness, extent, color, and position of clay films; and the amounts and distribution pattern of carbonates, and salts. Use the nomenclature for diagnostic features, such as slickensides, durinodes, and plinthite, in the horizon description.

(9) Reaction. Record reaction using the descriptive terms listed in Chapter 3 of the *Soil Survey Manual*. Give the pH value in parentheses following the descriptive terms.

(10) Range in thickness of individual horizons. Although this range is part of the range in characteristics for the soil series, include it in parentheses with each horizon description in the typical pedon for convenience. However, the combined thickness of subhorizons may be given.

(11) Examples of descriptions of individual horizons follow:

(i) A sequence of two horizons:

Oe1—0 to 20 cm; dark reddish brown (5YR 3/2) mucky peat, broken face hemic material, very dark brown (10YR 2/2) rubbed; about 60 percent fiber, 25 percent rubbed; massive; herbaceous fiber; about 15 percent mineral material; slightly acid (pH 6.5 in 1:2 0.01 M calcium chloride); abrupt smooth boundary.

Oe2—20 to 45 cm; very dark grayish brown (10YR 3/2) mucky peat, broken face and rubbed hemic material; about 40 percent fiber, 20 percent rubbed; massive; herbaceous fiber; about 35 percent mineral material; few small snail shells; strongly effervescent; slightly alkaline (pH 7.6 in 1:2 0.01 M calcium chloride); abrupt smooth boundary. (Combined thickness of Oe horizons is 15 to 50 cm.)

(ii) A sequence of three horizons:

E—2 to 25 cm; light yellowish brown (2.5Y 6/4) loam, very pale brown (10YR 7/3) dry; weak thin platy structure; soft, very friable, slightly sticky, non-plastic; few fine roots; few very fine pores; few fine black and dark brown concretions; 2 percent cobbles; strongly acid; clear smooth boundary. (15 to 30 cm thick)

Bt1—25 to 50 cm; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure; clean silt caps about 1 inch thick on tops of columns and clean sand grains on sides of columns; extremely hard, firm, moderately sticky and moderately plastic; common fine roots; many very fine vesicular pores in caps, many very fine tubular pores immediately below caps; few medium pores in lower part of columns; many distinct very dark brown (10YR 2/2) clay films on faces of columns; common dark stains on sides of columns; moderately alkaline; clear wavy boundary. (18 to 56 cm thick)

2Bt2—50 to 75 cm; olive (5Y 5/3) silty clay loam; moderate fine subangular blocky structure; hard, firm, moderately sticky and slightly plastic; few fine tubular pores; common fine prominent brown (10YR 5/3), many fine prominent yellowish brown (10YR 5/8) masses of iron accumulation; common fine prominent gray (10YR 5/1) iron depletions; common distinct very dark grayish brown (2.5Y 3/2) clay films in pores and on faces of peds; thin black (5Y 2/1) flecks inside peds; slightly acid; gradual wavy boundary. (15 to 35 cm thick)

(iii) A single horizon:

Cg3—125 to 150 cm; gray (10YR 5/1) silty clay loam; massive; firm, friable, moderately sticky and slightly plastic; few fine roots; few fine tubular pores; few medium distinct pale brown (10YR 6/3) masses of iron accumulation; common black (10YR 2/1) medium concretions and masses of oxide accumulation; common reddish brown (5YR 4/4) pore linings around former root channels; moderately acid; gradual smooth boundary.

(12) General guidance for preparing pedon descriptions.

(i) Use "few", "common", or "many" for classes of numbers of redoximorphic features, roots, pores, and concentrations. Refer to Chapter 3 of the *Soil Survey Manual* for a definition of the terms that apply to each of the features. Express rock fragments as a percentage of the volume.

(ii) Use "uncoated" or "clean silt and sand grains" rather than "bleached silt and sand" or "grainy coats."

(iii) "Ped" is the preferred terminology for a natural structural unit. Clods and fragments result from tillage or cultural practices. The term "aggregate" is confusing because it has many different meanings. Use the expression "faces of peds" and not "ped faces."

(iv) Avoid expressions such as "weak to moderate" for grade of structure (or other property). Use "weak and moderate" if two grades of structure are present. If peds separate to form smaller peds, use the verbs "part" or "separate" to describe the formation of secondary peds. In contrast to a complete ped, a fragment of a ped has fracture surfaces rather than natural faces. The zero grade of structure (structurelessness) is single grain or massive. Do not use the term "structureless" because it is redundant if used with "massive" or "single grain." Do not use secondary structure with massive or single grain.

(v) By definition concretions are cemented and hard. Thus, the phrase "soft lime concretions" is not correct. Use "soft calcium carbonate accumulations" or some other appropriate description. Preferred expressions are:

--common fine dark concretions (Fe & Mn oxides) or.

--common fine dark concretions (oxides).

(vi) Carbonates commonly are criteria to set apart soil series. Carbonates may be present in segregated forms or disseminated in parts of the mass or throughout the mass. Soil series descriptions must specify the kind and the distribution of carbonates within horizons.

The degree of effervescence after the soil is treated with 1N hydrochloric acid is described as very slightly, slightly, strongly, and violently effervescent. The degree of effervescence is related to the surface area of the carbonate minerals and to the kinds of minerals rather than to the total lime content.

Thus, effervescence is not a reliable basis for estimating the amount of carbonates. A small amount of finely divided carbonates can produce a violent effervescence for a short time. Field tests for estimating the amount of carbonates in a soil are available. Record the content in parentheses after the degree of effervescence, such as "strongly effervescent (8 percent calcium carbonate)". Estimate carbonates to the nearest 1 percent if less than 20 percent; and to the nearest 5 percent if it is more than 20 percent. An example is "slightly effervescent (2 percent calcium carbonate); slightly alkaline."

(vii) If E and Bt horizons are described, parts that refer to each horizon are indicated as follows:

E and Bt—95 to 145 cm; yellowish brown (10YR 5/4) fine sand (E); single grain; loose; lamellae and bands of dark brown (7.5YR 4/4) fine sandy loam (Bt); coarse subangular blocky structure in thicker bands; friable; wavy and discontinuous 2 to 4 mm thick lamellae in upper part and bands 5 cm thick in lower part; moderately acid; gradual wavy boundary. (40 to 75 cm thick)

(viii) Neutral colors are written such as N 5/. The hue is neutral (N) if the chroma is 0.

(ix) Do not place a plus sign after the last stated depth in the profile description. The last stated depth is the depth to which the profile was examined.

(x) Chapter 3 of the *Soil Survey Manual* and the 9th edition of the *Keys to Soil Taxonomy* give the designations used for horizons and layers.

(xi) Indicate the range in thickness of horizons as follows:

- The thickness of horizons that have two or more subhorizons can be combined. Note the range in thickness after the last subhorizon. For example, "The combined thickness of the Bw horizon is 50 to 75 cm .
- The thickness of horizons that are not essential to the classification and are not in all profiles is expressed as zero to an appropriate number of centimeters. For example, "0 to 60 cm thick."

(d) Type location. The location is a specific site, which gives the county and state names first. It is described accurately enough in relationship to map coordinates or other geographic reference points that it could be located by a person unfamiliar with the area. For example:

--Lucky County, Nebraska; about 10 miles north and 7 miles east of Eden; 90 feet west and 30 feet south of the northeast corner of sec. 7, T. 12 N., R. 26 W.; USGS named topographic quadrangle; lat. 40 degrees 40 minutes 20 seconds N. and long. 40 degrees 30 minutes 20 seconds W., NAD 83.

Give the latitude, longitude, and NAD, in both sectionized and non-sectionized areas. In sectionized areas, the four section corners and the center of a section may also reference points. Do not use the term "1/4 corners" in giving the location. In nonsectionized areas, give locations using available permanent landmarks.

(e) Range in characteristics. This section spells out observed ranges in soil properties for the soil series class as it is currently conceived. Give emphasis to properties that are definitive for the soil series or that affect use and management whether or not these properties are known to differentiate locally. As much as practical, give quantitative limits for the ranges in properties. The ranges specified must fall within the ranges of the family in which the soil series is classified. If the allowable range in a given property coincides with the range of the family or a higher category, the range does not have to be repeated in the description because it is implied by the classification given. A range in a soil series property commonly is narrower than the range for the family class. If it is, give the narrower range. If class limits in the classification system are soil series limits, observe these limits before recording their values. The ranges given are those that are considered to be limiting for the soil series and do not extend to taxadjuncts. The inclusion of unusual ranges in properties magnifies problems of identifying soil series apart from one another. Limit the recorded ranges to those that have been observed in the field or determined in the laboratory. Record assumed properties in the "Remarks" paragraph. This section of the soil series description, like others, is not meant to cover the inclusions of soils of other series within map units. Record such inclusions in the map unit descriptions in soil survey area handbooks, descriptive legends, and soil survey manuscripts rather than in the official soil series descriptions.

A standard arrangement of information in this section makes comparisons among soil series easier. Both tabular or text formats are acceptable. The arrangement first presents information on the soil as a whole, and then presents in subsequent paragraphs information on the major individual horizons.

(1) First paragraph.

Include general pedon features that apply to the soil as a whole rather than to individual horizons in this paragraph. Present such features as the thickness of the subsoil, depth to bedrock, depth to a fragipan, stoniness, mineralogy, range in soil temperature, and frequency and duration of periods when soil moisture is at or below the wilting point. Information that has been obtained through direct observations or that can be reliably inferred is recorded.

An example of a tabular format is:

Soil moisture: Moist in some part of the soil moisture control section December to March; intermittently moist July to September; driest in May and June; ustic moisture regime that borders on aridic.
Soil temperature: 9 to 13 degrees C.
Rock fragments: 15 to 50 percent gravel and 10 to 25 percent cobbles; average of more than 35 percent in the particle-size control section.
Calcium carbonate equivalent: 15 to 40 percent.
Depth to bedrock: 18 to 50 cm.
Reaction: Slightly alkaline or moderately alkaline.
Organic matter: Average of 1 to 5 percent in the surface layer.
Clay content: 18 to 25 percent; textures of loam or silt loam with less than 40 percent sand.

(2) Subsequent paragraphs.

Describe each major horizon of mineral soils in a separate paragraph. Separate each paragraph with a double space. Use tiers or combinations of similar layers for organic soils.

(i) The horizons covered in the subsequent paragraphs are the major ones described and are of consequence to the definition of the soil series. Discuss the ranges in soil properties in the same order as they are listed in the typical pedon description. An example of text format is:

"The Bt horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist or 3 or 4 dry, and chroma of 1 or 2 moist or dry. It is loam or clay loam. It averages 18 to 28 percent clay and 40 to 60 percent fine sand or coarser material. It has weak or moderate medium subangular blocky structure and is friable or very friable. It ranges from slightly acid to slightly alkaline."

An example of tabular format is:

Bt horizon
Hue: 10YR, 7.5YR.
Value: 2 or 3 moist, 3 or 4 dry.
Chroma: 1 or 2 moist or dry.
Texture: Loam, clay loam.
Clay: 18 to 28 percent.
Fine sand or coarser material: 40 to 60 percent.
Structure: Weak or moderate medium subangular blocky.
Moist consistence: Friable or very friable.
Soil reaction: Slightly acid to slightly alkaline.

(ii) Subdivisions of major horizons may be helpful for some soil series. The sequence begins with the uppermost horizon in the pedon and continues downward. Make subdivisions of major horizons only if necessary because the resulting long and detailed section may obscure important information.

(iii) List the most common range of a soil characteristic before giving the complete range. For example, "The A horizon commonly is loamy sand and less commonly is loamy fine sand, fine sand, or fine sandy loam" or "The A horizon is most commonly sand, but the range includes fine sand and loamy sand."

(iv) If there is no known range in a particular characteristic, do not repeat the information provided in the typical pedon.

(v) Preferred expressions are:

--"typically" or "in some pedons" rather than "frequently " or "occasionally;"
--"some pedons" rather than "some places", (For example, "The lower part of the fragipan in some pedons has evidence of illuviation.");
--"is" or "are" rather than "may be;"
--"2C horizon" rather than "2C material;"
--"bedrock" rather than "R" layer;
--"BC horizon" rather than "BC;"
--"Some pedons do not have a BC horizon" rather than "The BC horizon may be missing;"

--"the upper part of the B horizon" rather than "the upper B horizon;"
--"interfingering of albic materials into the Bt horizon" rather than "interfingering of the albic horizon into the argillic horizon;" and
--"a thin stone line is at the boundary between the two materials" rather than "a thin stone line separates the two materials."

Use terms for diagnostic horizons or features in this section. If you use these terms, specify their relationship to the horizons and subhorizons of the typical pedon.

(f) Competing series. This section discusses the distinctions between the soil series being described and its major taxonomic competitors. It lists all the soil series of the same family and gives the principal differentiating characteristics that set them apart from the series being described. Because the properties that govern the classification of the soil series being described have already been stated, this section emphasizes those features that distinguish it from the competing series. The comparisons are as specific and quantitative as available information warrants. Comparisons may include reference to diagnostic horizons and other features.

(1) List all soil series in the same family in alphabetical order. List tentative soil series if the series being described is tentative. If the soil series being described is established, list tentative series if they are identified as tentative. Individually state the differentiating characteristics for soil series in the order of listing unless some can be grouped together and differentiated. If no soil series are in the same family, list series that are in similar families and their differentiating characteristics.

(2) Features that are used to differentiate or group soils include, but are not limited to:
-- the presence or absence of a diagnostic horizon or feature,
-- the texture in some part of the series control section, (the range is given in percent of soil separates),
-- carbonates above or within a specified depth,
-- depth to a lithic or paralithic contact,
-- content or type of fragments in the soils,
-- soils that are redder or yellower than a specified hue,
-- redoximorphic features that have low chroma within a specified depth,
-- soil temperature differences,
-- the thickness of the subsoil,
-- the thickness of the epipedon,
-- soil moisture differences, and
-- reaction in the series control section.

(3) Change the following for preferred expressions:
-- in indicating that a soil has a mollic epipedon, change "thicker darker surface horizon" to "Gamma soils have a mollic epipedon;"
-- in distinguishing a soil that does not have a mollic epipedon, change "light colored surface" to "Gamma soils have an ochric epipedon;"
-- "lower subsoil" to "lower part of the subsoil;"
-- "are redder" to "have hue redder than 10YR;"
-- "soils lack argillic horizons" to "soils do not have an argillic horizon;"
-- "soils have higher organic matter" to "soils contain more than __ percent organic matter;"
-- "have siltier textures in the upper subsoil" to "contain more than __ percent silt in the upper part of the subsoil;"
-- "lower value" to "colors of lower value than;"
-- "moist value" to "moist color value;"
-- "small proportion" to "small part;"
-- "have up to and including 10 cm" to "have as much as 10 cm;"
-- "strongly developed horizons" to "strongly expressed horizons;" and
-- "Gamma soils have argillic horizons with fine-silty textures" to "Gamma soils have a fine-silty argillic horizon."

(g) Geographic setting. The items in this section include landform or forms, relief, nature of regolith, climate, and any landscape features that are especially helpful in identifying the soils of the soil series. Indicate the name or names of the landform(s) and the range in slope gradient, kind of slope, and aspect for the soils of the series. Record landscape features that mark areas of the soils, for example, common outcrops of rock, an erosional surface, or a depositional surface, in this section.

(1) Briefly describe the nature of the regolith in which the soils formed. Also list underlying rock. The purpose of this statement is to characterize the regolith as an aid in identifying the soils rather than to define the soil series in the terms of underlying rock and mode of accumulation of the regolith.

(2) Characterize climate in terms of temperature, precipitation, and indices. For example, express PE index as a range for the soil series. Only use indices that have been defined in widely available publications. Give information on climate in the descriptions of soil series. Give the range in the number of frost-free days if pertinent. The statements should apply to the section on setting and not to information on soil temperature and soil moisture that is given in the range of characteristics. If pertinent, give the range in elevation.

(3) Preferred expressions include:

-- "Gamma soils are nearly level" rather than "Gamma soils occur on nearly level,"
-- "The soil formed in calcareous" rather than "The soil developed in calcareous,"
-- "Annual temperature" rather than "Annual air temperature."

(h) Geographically associated soils. Use the list of geographically associated soils to inform users of the names of soil series in the same locality. For example, describe the actual geographic location of the series and how they differ. List the geographically associated soil series, and include a brief comment to distinguish each of them from the series being described. Relate the landscape positions of the associated soil series. The comments do not clearly differentiate soil series but rather highlight major distinctions. Do not repeat the differentiae that are used in the section on competing soil series. A preferred expression for "associated landscapes" is "nearby landscapes."

(i) Drainage and saturated hydraulic conductivity. Give soil drainage for each soil series, usually as a drainage class or classes. For some soil series, include segments of two adjacent drainage classes. Give the sequence of soil water states in addition to drainage class if it is a more useful way to record moisture regimes. Also include the characterization of saturated hydraulic conductivity in the section. Consider saturated hydraulic conductivity to a depth of 180 cm or to bedrock and describe it according to major changes, for example, "high in the upper part and moderately low in the lower part." Always cite very high saturated hydraulic conductivity in the lower part of the profile. Also give runoff in this section. If it is important, describe runon in this section. If needed, also give statements about flooding in this section. Avoid expressions such as "well drained to moderately well drained". Instead use "well drained or moderately well drained" or "well drained and moderately well drained". Do not assign more than two drainage classes to a soil series.

Examples of statements for drainage, runoff, and saturated hydraulic conductivity are:

-- Well drained. Medium runoff. Moderately high saturated hydraulic conductivity.
-- Moderately well drained; low runoff; moderately low saturated hydraulic conductivity. The soils are flooded for short periods in early spring.
-- Well drained. Runoff is medium on the gentle slopes and high on the steeper slopes. Saturated hydraulic conductivity is moderately high in the subsoil and low in the underlying material.

(j) Use and vegetation. List the major uses of the soil series in this section. If soils are used for crops, pasture, or forests or for urban or other uses, indicate the uses along with the general extent of each, if known. Do not discuss productivity levels, yields, limitations, or hazards. Also describe the native vegetation in this section if it covers an important part of the soil. If known, give the various plant communities in various successional stages. Refer to an ecological site if known. For some soil series, the kind of native vegetation is uncertain and no longer important because of current use. Do not describe the vegetation for these series. The description is brief since it is meant simply to aid in identifying the soils.

A preferred expression for "Soils are under cultivation with corn and wheat, the principal crops" is "Soils are cultivated. Corn and wheat are the principal crops."

(k) Distribution and extent. Indicate the extent of the soils of a soil series one of the three classes. The names and extent figures for these classes are given below. Use either the substantive and adjective forms of the name, depending on which is more appropriate for the text. The terms and the extent ranges are as follows:

--small extent or not extensive----less than 10,000 acres,

--moderate extent or moderately extensive----10,000 to 100,000 acres, and
--large extent or extensive----more than 100,000 acres.

Supplement the designation of classes for soil series with extent figures when the soil series is not extensive and when the soil series is of large extent. Examples are:

--"The soils of this series are not extensive; their total extent is about 6,000 acres."
--"The soils of this series are of large extent, about 200,000 acres in size."

(l) MLRA Office Responsible. Use this heading to indicate which MLRA Office has responsibility for maintenance of this OSD. Check the entry against a like entry in the Soil Classification (SC) file at the time of updating. Format of the entry should be: e.g., Portland, Oregon.

(m) Soil series proposed or series established. Use one of these headings, depending on the current status of the series. For tentative series, the place where the soil series was proposed and the date when the series received tentative status follow the side heading "Series Proposed." For established soil series, the place and date of establishment follow the side heading "Series Established." Give the names of the county and state and the year in which a soil series received tentative status or was established. If the survey area is a geographical or political subdivision other than a county, include the name of that subdivision. Give the source of the name for a soil series in the first description of a newly proposed series. A revised description does not need to include the source of the name if it has been recorded in an earlier description.

(n) Remarks. List the horizons and features that are considered diagnostic for the pedon described. The objective is a list of the features needed to classify and characterize the series. Restrict other remarks to those that can help in identifying soils of the soil series as it is currently conceived. For example, a proposal of a new soil series for soils originally from an already established series can be included in the "Remarks" section of the description of the new series. List any unresolved problem with defining the soil series or with differentiating it from others.

(o) Additional data. This section lists sources of data, including study thesis information, data from state laboratories, and advance copies of data from unpublished soil survey investigations reports that were used in defining properties of the soil series.

Part 617 – SOIL SURVEY INTERPRETATIONS

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Part 617 – SOIL SURVEY INTERPRETATIONS

617.00 Definition and Purpose.

(a) Definition

Soil survey interpretations predict soil behavior for specified soil uses and under specified soil management practices. They help implement laws, programs, and regulations at local, state, and national levels. They assist the planning of broad categories of land use such as cropland, rangeland, pastureland, forestland, or urban development. They are also used to assist in pre- and post-planning activities for national emergencies. Soil survey interpretations also help plan specific management practices that are applied to soils, such as irrigation of cropland or equipment use.

(b) Purpose

Soil interpretations provide users of soil survey information with predictions of soil behavior to help in the development of reasonable and effective alternatives for the use and management of soil, water, air, plant, and animal resources.

(c) Prediction basis

Prediction of soil behavior results from the observation and record of soil responses to specific uses and management practices, such as seasonal wet soil moisture status and the resultant effect in a basement. Recorded observations validate predictive models. The models project the expected behavior of similar soils from the behavior of observed soils.

(d) Features used for interpretations

Soil interpretations use soil properties or qualities that directly influence a specified use or management of the soil. Soil properties and qualities that characterize the soil are criteria for interpretation models. These properties and qualities include: (1) site features, such as slope gradient; (2) individual horizon features, such as particle size; and (3) characteristics that pertain to soil as a whole, such as depth to a restrictive layer. Soil interpretation criteria may change with technology.

(e) Basis for features

Laboratory and field measurements, models and inferences from soil properties, morphology, and geomorphic characteristics provide the values used for estimating soil properties. Sources of laboratory data commonly are the Soil Survey Laboratory, Agricultural Experiment Station laboratories, and State Highway Department testing laboratories. Pedon descriptions record field measurements, field observations, and descriptions of soil morphology. Develop lab sampling plans to fill data gaps. Changes to soil features in the database change soil interpretive results. Soil scientists prepare entries and change entries with interdisciplinary assistance of engineers, agronomists, foresters, biologists, resource conservationists, range conservationists, and others.

(f) Scope

(1) National interpretations. National soil survey interpretations are nationwide in scope and application, and are mandated by federal legislation, policy, or regulation. National interpretations cannot be modified for state or regional uses because they are designed exclusively for national use across all political boundaries by NRCS and other agencies. Federal programs use national soil interpretations. Examples of national soil survey interpretations are highly erodible land, prime farmland, "T" and "I" factors, hydric soils, and

the entire suites of interpretations designated with "MIL" (military) and "DHS" (Dept. of Homeland Security) as part of their name. The federal agency that is responsible for the mandated program provides the leadership to develop the criteria and documentation cooperatively with the National Leader for Soil Survey Interpretations.

(2) Standard interpretations. Standard soil survey interpretations and their related criteria that are nationwide in scope and application but are not mandated by federal legislation, policy, or regulation. These interpretations and their criteria are the national standard. The soil survey interpretations generated by these criteria and templates are provided in soil survey publications, data downloads from the Soil Data Mart, Web Soil Survey, and other soil reports. Most surveys use standard interpretations.

(3) Regional, state, or local interpretations. Regional, state, or local soil survey interpretations are local or regional in scope and application. These interpretations and their related criteria support interpretations within a local area or region.

(g) Development

The cooperators in the National Cooperative Soil Survey develop soil interpretations to support user needs. The Natural Resources Conservation Service maintains them. Published soil surveys include soil interpretations. Thematic maps produced from geographical information systems (GIS) provide an alternate interpretation format.

(h) Application and documentation

An individual soil survey area may have a wide range of land uses for which soil interpretations are developed, maintained, and published. Local, state, and MLRA offices and National Cooperative Soil Survey participants select the land uses and primary interpretations to be published. The soil survey memorandum of understanding documents these selections.

(i) Additional interpretations

National Technology Support Centers, states, and cooperators develop additional interpretations after publication for users requesting assistance. Interpretation developers must appropriately label and date these interpretations. They must provide metadata such as the discipline specialists that developed the interpretation, the status of testing, validation and certification, and the intended extent of the soil interpretation's applicability.

617.01 Policy and Responsibilities.

Soil survey interpretations are generated within the National Soil Information System using the soil properties that are stored in the Soil Data Warehouse. Exact joins across county and state lines ensure consistency of the actual and visual presentations of soil interpretations in the Web Soil Survey across these boundaries. Soil survey products use generated interpretations. Do not adjust the ratings. Ratings that are contrary to the experience of those persons familiar with the soil and other performance standards of users should be evaluated. If the performance of the soil is not consistent with the computer estimates, review the soil properties and selected criteria. Also review the assumptions and definition of the practice being rated. A new interpretation with new criteria may be needed.

(a) Null values and consistency of entries.

Completely populate all data elements that are used as criteria in an interpretation in order to generate reliable interpretations. Data fields with null values or missing data cause the soil interpretation to fail and tables will carry the phrase "not rated" for these components. To ensure consistency of soil property data entries, the procedures in part 618 are to be used. Because many entries are subjective and up to interpretation by the soil scientist, training within Major Land Resource Areas is encouraged.

(b) Populating major and minor components.

Completely populate the data elements for major and minor components including map unit components that are entered as series, taxadjunct, family, taxon above the series and miscellaneous areas except as noted in 617.01(d).

(c) Application of national interpretations.

National program applications use national interpretations and deviations by states or other offices are not allowed.

(d) Agreement on the use of interpretations.

The memorandum of understanding states which interpretations will be made for a soil survey area. The MLRA office, state soil scientist, and cooperators agree on whether or not to generate interpretations for miscellaneous land types and minor soil components. The Soil Survey Division encourages the entry of appropriate data and preparation of soil interpretations for miscellaneous areas. Omission of entries to select data elements is by joint consensus of the MLRA office, state soil scientist, and cooperators.

(e) Deviation from standard interpretations.

Deviations from the nationally supported standard interpretations and their related criteria are documented and renamed by the state. Interpretation development follows the procedure in part 617.10.

(f) Retention of criteria and documentation.

Offices creating local, state, or regional interpretations retain the criteria and performance documentation.

(g) Responsibilities.

(1) The National Technology Support Centers are responsible for:

(i) regional multidisciplinary coordination and quality assurance for the development and maintenance of regional interpretive criteria and information for private and state lands.

(2) The MLRA regional office is responsible for:

(i) assuring that soil data entries meet national standards for data population (part 618 NSSH) and that soil data are correlated among surveys within a major land resource area;

(ii) reviewing interpretations to assure correlation, technical accuracy, and consistency of the soil data and interpretations across MLRA boundaries;

(iii) assuring that soil performance is correlated to soils according to current policy and guidelines; and

(iv) maintaining the criteria and templates for regional interpretations within National Soil Information System.

(3) The state soil scientist is responsible for:

(i) coordinating with the responsible MLRA soil survey office in order to ensure the accuracy, consistency, currentness, and completeness of all soil data in the National Soil Information System (NASIS) database and the field office technical guides;

(ii) assisting soil survey users in understanding and applying soil survey information;

(iii) maintaining the criteria and templates for state and/or local interpretations within the National Soil Information System;

(iv) coordinating the development of state or local soil interpretations as needed;

(v) fully documenting state and/or local interpretations as outlined in 617.10;

(vi) maintaining the criteria and templates for state and local interpretations;

(vii) ensuring the technical content, coordination, and quality of soil information in the field office technical guides;

(viii) providing soils input to all NRCS program activities; and

(ix) migrating NASIS data to the Soil Data Warehouse.

(4) The appropriate representative of federal agencies is responsible for the soil interpretations for federally administered lands.

(5) The National Soil Survey Center is responsible for:

(i) developing policy, standards, guidelines, and procedures for making soil interpretations;

(ii) approving and maintaining the criteria, templates, and documentation for all national interpretations in cooperation with specific disciplines at the national level;

(iii) coordinating with other disciplines and program managers in the development of soil interpretations with national application;

(iv) initiating regional soil interpretation reviews for standard interpretations through the National Technology Support Centers;

(v) sharing and providing guidance on soil interpretations that are used in soil survey publications, reports, and databases; and

(vi) providing training in developing, maintaining, storing, and retrieving soil interpretations.

(6) Program areas and various disciplines determine the policy for acceptance or application of interpretation criteria for specific uses.

(i) Responsibilities for engineering interpretations are in the National Engineering Manual part 533.22 (http://policy.nrcs.usda.gov/scripts/lpsiis.dll/M/M_210_NEM.pdf).

(ii) Soil-related fish and wildlife interpretations and responsibilities are provided in the National Biology Manual part 512 and part 513.15 (http://policy.nrcs.usda.gov/scripts/lpsiis.dll/M/M_190_NBM.pdf).

(iii) Soil-related forestry and agroforestry interpretations are provided in the National Forestry Manual part 537 (http://policy.nrcs.usda.gov/scripts/lpsiis.dll/M/M_190_NFM.pdf).

(iv) Soil interpretation responsibilities and application on range and pasture land are described in the National Range and Pasture Handbook part 600.0305 and other parts of chapter 3 (http://policy.nrcs.usda.gov/scripts/lpsiis.dll/H/H_190_NRPH_3.pdf).

617.02 Interpretations for Map Unit Components and Map Units.

(a) Interpretations

Soil interpretations support (1) detailed soil survey maps, such as from the Soil Survey Geographic (SSURGO) database, (2) general soil association maps; such as from the General Soil Map of U.S. (formerly called STATSGO) database; and (3) the more general soil maps, such as from the national major land resource area map.

(1) Soil map unit components

(i) Soil survey interpretations primarily address soil map unit components. Most map unit components have a complete set of data elements sufficient for making interpretations, but some components lack needed data. The completeness and accuracy of data and information that are used as soil interpretation criteria determine the accuracy of interpretations. Components lacking necessary data for any interpretation will receive a "not rated" result. Soil scientists review the completeness and accuracy of the database prior to release of interpretations to users. The reports from the National Soil Information System interpretation generator show where data are missing.

(ii) Map unit components that are miscellaneous areas may have adequate data available to generate some standard interpretations, and may be listed in interpretive tables. Otherwise, suitabilities and limitations can be developed by onsite investigation.

(2) Soil map unit

(i) Soil survey interpretations can represent the map unit as a whole. Performance statements which apply to soil map units as a whole use two methods for presentation: (1) as percentages of the unit with a specific rating, such as "map unit Alpha-Beta complex, 0 to 3 percent slopes is 60 percent well suited and 40 percent poorly suited for the specified use" or (2) as a single rating that was averaged from values or determined from preset percentages, for example, a single yield of crops is given, which may have been calculated on a weighted average based on the percent composition of the map unit.

(ii) Generally, map unit interpretations are the result of queries from users, who may need information on the major components of a map unit or information on the minor components if the minor components are important to a specific use.

(b) Generalized applications

Interpretations for map units displayed on large scale maps, such as the U.S. General Soil Map (STATSGO), the major land resource area database, or from other general soil maps, are more general than the interpretations displayed from smaller scale maps, such as from the U.S. Soil Survey Geographic (SSURGO) Database and other detailed soil survey maps. General soil map units of the General Soil Map commonly contain more map unit components or more broadly defined soil property ranges in characteristics than the map units of the more detailed soil survey maps of SSURGO. Performance statements for general soil map units apply to the map unit as a whole and express the percentage of the map unit that meets the performance criteria. For example, "the Alpha-Beta-Gamma map unit is 60 percent well suited, 25 percent poorly suited, and 15 percent unsuited for the specified use."

617.03 Developing and Maintaining Interpretation Guides and Ratings.

(a) Standard ecological interpretative group guides

Standard ecological interpretation groups rely on criteria and information for interpreting soils as referenced in part 622 or as approved separately by the National Leader for Soil Survey Interpretations and other national disciplines.

(b) Responsibilities

The National Leader for Soil Survey Interpretations leads the development, maintenance, and revision of soil interpretive technology and develops policy relating to the application of soil data for standard and national interpretations. Discipline specialists; such as agronomists, foresters, and range conservationists; are essential to the development of soil interpretation guides and standards and in the technical transfer of the resultant interpretations and information to users.

(c) Level of development

State, regional, or national offices develop soil interpretations and related guides. Interdisciplinary teams develop soil interpretations and related guides for specific soil interpretations. Specialists concerned with a given land use or resource work together in developing the initial criteria, field-testing the criteria, and developing the final guide for interpreting soils for a specified use. The procedure outlined in part 617.10 governs the development and documentation of the proposal.

617.04 Reviewing and Implementing Soil Interpretative Technologies.

(a) Proposed changes to standard interpretations.

A project soil survey staff, state office staff, advisory group, conference committee, National Cooperative Soil Survey participant, National Soil Survey Center personnel and other disciplines specialist may propose soil interpretative guides and criteria changes. The National Leader for Soil Survey Interpretations will ensure that all soil interpretations criteria will be reviewed on a regular basis. These proposed changes to standard soil interpretative criteria and guides are submitted to the National Soil Survey Center, National Leader for Soil Survey Interpretations for distribution for peer review.

(1) The National Leader for Soil Survey Interpretations assigns a sponsor for each interpretation. For criteria changes initiated at the NSSC, the National Leader for Soil Survey Interpretations is the sponsor.

(2) National Technology Support Center representatives are the review coordinators for the National Leader for Soil Survey Interpretations. The review coordinators summarize all regional feedback and provide information to the National Leader for Soil Survey Interpretations for action.

(3) The sponsor prepares a "full description" as described in part 617.10; assembles documentation, copies of technical references supporting the current and proposed criteria, for any NSSC, state, or regional variation to the interpretation. The sponsor prepares a list of contacts that support the variations to the standard interpretation and works with regional soil interpretations coordinating team that consists of soil scientists and other disciplines from NRCS and other agencies. These teams are standing or ad hoc committees within the regional conference committee structure.

(4) The regional teams:

(i) review the purpose and the scope of the interpretation;

(ii) compare the standard template to the locally tailored interpretations with attention to the documentation provided for the local interpretation;

(iii) determine if any current soil properties used in the standard interpretation are repetitive, should be dropped, rewritten, or if additional properties should be added based on local criteria;

(iv) evaluate technical references or documentation that must accompany suggested changes;

(v) determine if criteria used in local variations warrant using them in standard criteria;

(vi) determine research needs to support criteria changes;

(vii) identify problems or questionable areas with the current or proposed criteria;

(viii) develop documentation for recommended changes in properties or criteria; and

(ix) provides a recommendation to the interpretation sponsor.

(5) The interpretation sponsor monitors and assists each regional team's activities and progress and with their input consolidates the recommendations of each into one recommendation to the National Leader for Soil Survey Interpretations.

(6) The National Leader for Soil Survey Interpretations provides a cooperator comment period before the standard interpretation is finalized in concert with other national discipline specialists and before it is implemented in NASIS.

(7) The National Leader for Soil Survey Interpretations arranges for all NCSS cooperators to be notified of changes that have been made to an interpretation.

(b) Regional, state, or local interpretation submissions.

Submission of regional, state, or local interpretations to the National Leader for Soil Survey Interpretations will ensure these developments are shared with potential users. Soil interpretations must meet the requirements outlined in part 617.10. Field observations, research (laboratory and field), and other documentation should support them.

617.05 The National Soil Information System.

The National Soil Information System (NASIS) stores soil survey data, soil performance, and interpretation criteria. Soil interpretations attach to map unit components. Part 618 of this handbook discusses specific data entry. NASIS stores all necessary criteria for computer generated interpretations. Changes to soil properties made in NASIS do not generate new interpretations in the Soil Data Warehouse until they are exported from NASIS to the warehouse.

The National Soil Information System depends on adherence to National Cooperative Soil Survey policy and procedures and consistent and complete entry of specific soil properties.

617.06 Presenting Soil Interpretations.

The method by which soil interpretations are presented, such as tables, databases, interpretative sheets, thematic maps, and special reports provides easily understood soil limitations, suitabilities, or potentials for a specific use. Thematic maps effectively present soil limitations and potentials. A series of thematic maps, each focusing on a single soil attribute or interpretation helps many users. For more general use, tables or narrative forms of soil interpretations and potentials are the more common technique.

617.07 Updating Soil Interpretations.

(a) Changes in application

The evaluation and maintenance of soil interpretations is a dynamic process. Changes in soil use or land management practices may require new, revised, or updated interpretations. Soil use changes initiate the revision of soil interpretations. Soil interpretations are updated periodically as more information is gained about a soil and its behavior or as soil properties change due to activities by human activity or nature. Interpretations may change due to changed entries for soil or landscape features or from changes in interpretive criteria. The change is applied when the NASIS data is exported to the Soil Data Warehouse or downloaded directly from NASIS reports.

(b) Changes in soil information

Soil maps contained in published soil surveys generally remain valid for many years. However, the information about the soils that are delineated on the maps is continually updated and enhanced as research is conducted or as new kinds of data are collected and entered into the information system.

(c) New uses

New uses for a soil or new practices that have no existing soil interpretations may become important in an area and thus require the development of new interpretations or the modification of an existing interpretation for a similar use or practice.

617.08 Coordinating Soil Survey Interpretations.

(a) Similar soils

For the major land resource area, specific interpretations for similar phases of a named kind of soil are identical except for minor differences that can be justified by local variations, such as in climate or topography. Similar soils by definition have similar interpretations. In order to generate similar interpretations, soil landscape and soil features and properties must be the same or utilize the same data map unit and interpretation criteria. Interpretations in field office technical guides and soil handbooks are generated from properties and interpretation criteria.

(b) Coordinating soil properties and features used in soil interpretations

Soil data entries and joining are the basis for coordinated soil survey interpretations. Responsibility also consists of coordinating with the adjoining regions and reviewing measured and observed data from all areas in which similar map units occur. State and local program-specific interpretive groups and special interpretative criteria are the responsibility of the state soil scientist.

617.09 Writing Soil Interpretation Criteria.

Developing interpretations criteria involves the user. Interdisciplinary involvement is required in developing criteria for interpretations in order to assure that the needs of potential users are addressed. Also consider the clarity, accuracy, and the ability of the criteria to be easily created and modified. Local, state, regional, and national offices develop criteria to represent user needs. They follow a consistent procedure and firmly establish principles for documentation. Consider the ease of development and the stability of the interpretation. Use the expert judgment of specialists and the scientific literature as resources. People who work with the intended use and application know more than what can be speculated by those people with less experience. The following steps lead to the goals for interpretation criteria.

(a) Define the Activity.

Clearly and very specifically define the activity or use to be interpreted. Cite references that help to define the activity. Literature citations, such as information from the State Health Department, bulletins, or soil performance research, support the decision made and help track the procedure. When defining the activity:

(1) describe the activity or use;

(2) identify the purpose or purposes of the activity or use;

(3) define the desired performance of the activity or use;

(4) specify the soil depths that are affected;

(5) identify the type of equipment for installation;

(6) mention resource conditions that indicate a different activity or use or the misuse of this practice;

(7) define the needed specific geographic detail, including the length and width and the direction of application if important; and

(8) define the needed map and interpretation reliability and uniformity.

(b) Separate Aspects.

Separate different aspects of the activity for separate interpretations. Aspects of interpretations are planning elements that require different criteria, such as installation, performance, maintenance, and effect. Proceed through the steps to develop criteria for each aspect. Each aspect is a unique interpretation that has separate criteria and users. Mention other aspects that may need interpretation but are not addressed.

(c) Identify Site Features.

Identify significant site features significant for the interpretation and any assumptions about them. Site features are not soil properties, but are instead features such as climate factors, landscape stability hazard, vegetation, and surface characteristics. Identify and record the implied affect of site features on each aspect of the interpretation. Although site features are not soil properties, they are commonly recorded on soil databases and are valuable for developing interpretations because they are geographically specific to soils.

(d) List Soil Properties.

Identify and list all specific soil properties that are significant to the interpretation. Use only basic properties, qualities, or observed properties. Do not make interpretations from previous interpretations or models. Generally, terms that refer to classes fit in this category. Only use derived soil qualities when they are derived within the criteria to ensure the integrity of the data and the resultant interpretation. Terms used as properties or qualities that have inconsistent entries or derivation pathways result in inconsistent interpretations. Concentrating on the basic influencing property that has the most consistent database entries provides for more consistent interpretations. For example, consider the soil moisture status during a construction period and not the drainage class. Minimize the list of properties by identifying only the basic properties. Review the list to ensure that the same property is not implied several times. For example, USDA texture, clay, and AASHTO do not need to appear on the same list.

(e) Select the Number of Separations.

Select the number of interpretative separations, and define the intent of the separation or classification. Each separation should have a purpose, which normally represents a significant management grouping and a need for separate treatment. Commonly used terms in separations are slight, moderate, and severe or good, fair, and poor. User needs dictate the number of separations. The levels of user needs may vary. Some users do not use groupings.

(f) Document Assumptions.

Document assumptions about the significance of the property and established values for separating criteria.

(1) A record of the significance of the property helps to define the property and allows for future understanding and modification. It provides a basis for the criteria so that changes can be made if different equipment is used.

(2) Indicate why the feature is important and why the specific break was chosen, such as why 6 percent slope was used instead of 10 percent slope. If the limit is arbitrary or speculated, state that it is but also indicate the intent of the separation. The new interpretation generator recognizes the progressive effect of a property on the interpretation. The curve for approximate reasoning (fuzzy logic) reflects the increasing, decreasing, or constant effect that varying degrees of a property have on the interpretation. The evaluation phase of the interpretation generator uses the curve.

(3) Establish values that are significant to the interpretation and not to the mapping. The values should represent the significance to an activity. Do not consider how soils were grouped in mapping since these groupings may have been made for other interpretations.

(g) Develop the Criteria Table.

Assign feature and impact terms, and develop the criteria table. The following categories of column headings are recommended for use in the criteria table:

(1) Factor (this is the soil property);

(2) Degree of Limitation (such as slight, moderate, severe);

(3) Feature (the term to be displayed for soil property); and

(4) Impact (the dominant impact that the soil property has on the practice being rated).

Information in the feature and impact columns is helpful in designing ways to overcome the limitation. Ensure that all terms are added to data dictionary.

(h) Application, Presentation, and Testing.

(1) Database needs.

Provide a description of the calculation procedure. The calculation procedure is a set of instructions for the correct access to dataset entries. It is needed to sort criteria from a database without questioning the intention of the interpretation. The description should be specific to the database being used. Instructions for using high, low, or central values of data should be given in this description.

(2) Temporal considerations for application.

Identify time dependent or temporal properties or events from the measured permanent features of the soil.

(i) Flooding and periods of freezing, wetness, or dryness are significant at the time they occur but not at all times. For example, in planning an installation phase, remember that this phase can be scheduled for alternate times when these events are not significant to the criteria. In these situations, temporal properties should not be part of the criteria unless a practice is being rated for a particular time of the year.

(ii) If temporal events are important for the permanent performance of the interpretation, then include them in the rating criteria.

(iii) State the soil moisture condition or the time of the year to which the interpretation applies. Since the conditions of soil moisture and soil freezing vary throughout the year and these conditions affect soil properties, criteria should define stated moisture conditions. Criteria can be developed for different times of the year by defining the criteria for the conditions that exist at the desired time of the year. Information on soil moisture status and freezing conditions are in the National Soil Information System.

(3) Reliability.

(i) Each soil property has a reliability connected to it. Soil property entries may come from measurements, derivations, or estimates. Consider the soil property reliability to inform the users of the reliability of the expected interpretation.

(ii) Properties vary according to time of the year. If so, specify a time of the year for the interpretation. The reliability of the interpretation often depends on the seasonal variation of the property. Information presented to the user on temporal variation helps to describe the reliability of the interpretation.

(iii) Geographic reliability refers to the aerial extent to which an interpretation can be applied. Statements about the consistency, variability, or uniformity of a soil delineation help to define the geographic reliability of the interpretation.

(4) Testing.

Interpretations should be tested against the actual effects on activities or practice performance. Many properties and criteria need further refinement before they can be used. Some terms, such as flooding, require clarifying statements such as for velocity, depth, or duration. Sources of information other than the National Soil Information System soil interpretations may be available and should be considered at this stage of criteria development. Also consider related refinements and onsite investigations.

(i) Keep in mind that a soil interpretation is for planning purposes. Additional refinements or other resource information can be used for site selection. Soil interpretations alone may not answer all the questions. Inform the intended user about other information that may be needed. Honestly express the limitations of the interpretation but do not undersell the information. Many users have no other resource information.

(ii) For the final site selection, an onsite investigation may be needed to provide information more specific than that collected and stored in a standard soil survey. Onsite investigation is recommended for expensive installations and for the determination of design criteria.

(iii) Use benchmark soils for testing interpretations. A benchmark soil and site description and the desired interpretation rating may help to stabilize the criteria. As criteria is developed and adjusted, test the criteria against the benchmark set of properties.

(iv) Report suspected errors and/or discrepancies in criteria or constructed interpretation logic to the owner of the interpretation. Contact the National Leader for Soil Survey Interpretations for national or standard interpretation errors. When reporting suspected errors in an interpretation include:

- name of the interpretation;
- description of the suspected error;
- if known, detail the elements, rules, evaluations, properties or logic construct that are the problems; and
- reference one or more soil survey map unit components that demonstrate the error.

(v) Interpretation owner will review and evaluate the reported error:

- determine if the interpretation indeed contains an error from its original intent;
- if after review and evaluation the owner determines that the interpretation is functioning as designed, notify the person reporting the error; and
- if the interpretation does have an error, notify state soil scientists and NCSS cooperators of the interpretation that contains the error and consider changing the interpretation from "Ready to Use" status to "No" in NASIS.

(i) Date the Interpretation and Criteria.

It is very important to date the criteria and the interpretation tables. As criteria are modified, it may not be apparent that the tables were not generated from current criteria.

617.10 Documenting Soil Interpretation Criteria.

(a) General.

It is important to document information used during development and maintenance of soil interpretations. Soil interpretation users should be able to locate information and references used to develop the interpretation's rules and criteria. Information regarding the interpretation's ratings and the person who developed the soil interpretation are helpful in testing or validating interpretations and for determining the geographic extent of intended use of the interpretation. The standard procedure to document soil interpretations is within the National Soil Information System. This assures critical information accompanies products delivered through the Soil Data mart and Web Soil Survey.

(b) Levels of interpretation documentation.

Three levels of interpretation documentation are provided for national, standard, regional, state, and local interpretations.

(1) Summary Description – a one to two page narrative summary of the intent of the primary interpretation, its scope, general description of the interpretive criteria, and citations used to support criteria.

(2) Mid-Level Description – a more detailed description. It includes contents of the Summary Description plus a description of each interpretive criteria (sub-rule) used in the primary interpretation. It provides the NASIS properties that are used to retrieve data from the NASIS database.

(3) Full Description – information from the Mid-Level Description and the details of data evaluations used in the interpretation.

(c) Development and storage of documentation.

(1) Summary Description – store as pre-written text in the Rule Description field of the primary rule in the rule table in NASIS (see example of each below).

(2) For child rules, evaluations, and properties, store a description of each in their respective description field in their respective table in NASIS (see Exhibit 617-1).

(3) NASIS reports have been written to generate the Summary, Mid-Level, and Full interpretation description versions as outlined above. These NSSC Pangaea reports are:

(i) INTERP – Rule and Criteria Narration – full

(ii) INTERP – Rule and Criteria Narration – mid-level

(iii) INTERP – Rule and Criteria Narration – summary

Note: To run these reports in NASIS, all that is needed is to have the primary rule in the selected set.

(4) During export to the staging server, these three reports will automatically be run and the results stored in the export file.

(5) These same reports will automatically run when interpretations are updated or added to datasets on the staging server.

(6) In the Soil Data Mart, new national reports will pull the generated interpretation descriptions from the database. These reports will also be added to the Access template and be available through the Web Soil Survey.

(d) Responsibility.

(1) The Summary Description text and descriptions for each child rule, evaluation, and property are to be developed by the owner of each entity.

(i) The National Leader for Soil Survey Interpretations maintains documentation for all national and standard interpretations and their component parts.

(ii) Each state or local entity is responsible for completing and maintaining documentation for their respective state or local soil interpretations.

(2) This scheme facilitates a standard delivery mechanism for documenting NASIS interpretations.

617.11 Requirements for Naming Reports and Interpretations

The Soil Data Mart allows the state soil scientist to develop a list of available reports for their particular state. This enhancement requires the development of a state SSURGO Access template database to include the desired state reports. The following procedures are necessary to provide the management of tailored reports requested by each state.

(a) Downloading national reports.

If a state chooses to accept the national reports on the Soil Data Mart, and exports only the national/standard interpretations from NASIS to the Soil Data Mart, no additional action is necessary.

(b) Developing local reports, modifying national reports, or creating new reports.

The following require a tailored SSURGO Access template detailing the exact modifications to be made for the state's Soil Data Mart reports:

(1) developing local interpretations, e.g., Sewage Lagoons (VA) or Dwellings with Basements (NC);

(2) modifying existing national soil property reports, e.g., Chemical Properties (CA) or Water Features (CA); or

(3) creating a brand new report, e.g., Soil Fact Sheet (VT).

This state-tailored Access template is used to create the state reports on the Soil Data Mart.

(c) Requirements for creating a local interpretation from a national interpretation.

When creating a local interpretation from the national/standard, e.g., "ENG - Septic Tank Absorption Fields", modify the following in NASIS:

(1) Naming Convention.

(i) Use the same prefixing protocol established for NASIS interpretations (see table below) and the interpretation text name as used for the national/standard interpretation "Rule" name.

Ag Waste Management	(AWM)	Recreation	(REC)
Agronomy	(AGR)	Standard Engineering	(ENG)
Dept. of Homeland Security	DHS	Urban	(URB)
Forestry	(FOR)	Water Management Systems	(WMS)
Grazing Land	(GRL)	Water Quality	(WAQ)
Military	(MIL)	Wildlife	(WLF)

(ii) Modify this interpretation "Rule" name in NASIS to include the two-letter FIPS state code or agency codes (BLM, FS, NPS, etc.) in parentheses, preceded by one space, after the Rule name, e.g., "ENG – Septic Tank Absorption Fields (OH)" or "WLF – Desert Tortoise Habitat (BLM)".

(iii) Use only state FIPS codes or agency codes. Do not use terms such as MOxx, initials, survey area, etc.

(2) Documentation. Use the description field in the NASIS rule table to fully document the state-created interpretation (including "Summary", "Description", "Scope" with source citations and "Criteria" detailing the rule, evaluation, and property as outlined in 617.10.) See national rules for examples of acceptable format and content.

(3) Sharing interpretations developed by other states. To use a local interpretation created by another state or agency, copy and paste the primary interpretation (in NASIS) and change the state or agency code to reflect the new state code or simply export the interpretation as named even though it will contain a different state code.

(4) Reports name and title. Change the reports in the Access template to display the local interpretations:

(i) Use the report name and title for the local interpretation as described above.

(ii) Column headers for local interpretations include the FIPS code or agency code, but not the three-letter prefix code (ENG, WMS, etc.), e.g. Sewage Lagoons (VA).

(iii) Edit the Access Report Documentation field to provide an explanation of the use of the state code designating the interpretation as one that has been developed using local criteria. Inform the user of any significant criteria differences or criteria references necessary to understand the use of the interpretation.

(d) Requirements for modifying existing national soil property reports.

If a national properties report is modified (e.g., removal of the "gypsum" column from the Chemical Properties report), the following changes are needed:

(1) Report Name (displayed on drop-down menu on Soil Data Mart). Add the state two-letter FIPS code or agency code to the report name to identify "State" modification of the report, e.g., Chemical Soil Properties (CA). Place the two-character state code in parentheses, preceded by one space, after the report name. This state "report name" supersedes the national report and replaces the national report. The Soil Data Mart drop-down list is alphabetically arranged. Multiple versions of the same report may be used within a state with the names modified to distinguish between them, e.g., Chemical Soil Properties (CA), Chemical Soil Properties for Volcanic Soils (CA).

(2) Name Modification. Use only state codes or agency codes (BLM, FS, NPS, etc.) as modifiers to the report name. Do not use terms such as MOxx, initials, survey area, etc.

(3) Report Title. The report title is the actual title on the printed report page. The report title is changed to match the report name, e.g., Chemical Soil Properties (CA).

(4) Documentation. The Report Documentation field in the Access template table "SYSTEM - Soil Reports" is edited to reflect any report modification. This prewritten material is specific to the report and is reviewed by editorial staff.

(e) Requirements for creating a new report.

When creating a new report that does not replace a national report (e.g., "Soil Fact Sheet" created by Vermont), take the following actions:

(1) Develop the Report Name. The report naming convention should include the state code or agency code as described above, e.g., "Soil Fact Sheet (VT)".

(2) The new state-specific report is intermingled alphabetically with the national reports.

(f) Detailed instructions for modifying the Access template database.

See the document titled "SSURGO_Template_DB_Customization_Guide.doc" for detailed instructions for modifying the Access template database at http://nasis.nrcs.usda.gov/downloads/ under "Microsoft Access SSURGO Template Databases."

(g) Use of the national template.

Download the national template at http://soildatamart.nrcs.usda.gov/Templates.aspx. Modify this template with state reports and submit to the National Leader for Soil Survey Interpretations for inclusion in Soil Data Mart.

(h) Editorial review.

Submit all reports developed and/or modified by a state, including report descriptions, to the National Leader for Soil Survey Interpretations for review by the editorial staff. This includes all local reports in existing Access templates.

(i) Coordination and template delivery to the Soil Data Mart.

(1) The National Leader for Soil Survey Interpretations coordinates all editorial, consistency, and look and feel issues with state soil scientists, MLRA offices, editors, and others.

(2) The National Leader for Soil Survey Interpretations provides the final Access template to the ITC staff for template delivery to the Soil Data Mart website and for development of the State Soil Data Mart reports. Access templates are not posted directly to the staging server.

Exhibit 617-1 Example of Descriptions for Documenting Interpretations.

Example Documentation of Interpretations

Following are examples of documentation content for rules, evaluations, and properties. These paragraphs are used as content to generate the Interpretation Documentation reports in NASIS described above.

The following is in the Description field in Rule table of a Primary rule:

WMS-Grape Production with Drip Irrigation

Summary: Soil interpretations for "WMS-Grape Production with Drip Irrigation" evaluate a soil's limitation(s) for drip irrigation of grapes. This irrigation system applies water at a very slow rate near the plants. The ratings are for soils in their natural condition. Present land use is not considered in the ratings.

The degree of limitation is expressed as a numeric index between 0 (nonlimiting condition) and 1.0 (most limiting condition). If a soil's property within 150 cm (60 inches) of the soil surface has a degree of limitation greater then zero, then that soil property is limiting and the soil restrictive feature is identified. The overall interpretive rating assigned is the maximum degree of limitation of each soil interpretive criteria that comprises the interpretive rule. Lesser restrictive soil features are those that have a degree of limitation less then the maximum and are identified to provide the user with additional information about the soil's capability to support the interpretation. These lesser restrictive features could be important factors where the major restrictive features are overcome through practice design and application modifications.

Soils are assigned interpretive rating classes on the basis of their degree of limitation. These classes are "not limited" (degree of limitation = 0), "somewhat limited" (degree of limitation >0 and <1.0), and "very limited" (degree of limitation = 1.0).

The "Grape Production with Drip Irrigation" interpretation was developed by the Davis, California interpretation staff in cooperation with the University of California-Davis, and is NOT DESIGNED NOR INTENDED TO BE USED IN A REGULATORY MANNER. Drip irrigation is the controlled application of water to supplement rainfall for grape production. The soil properties and qualities that affect design, layout, construction, management, or performance of the irrigation system are evaluated and their degree of limitation determines the final rating.

Scope: Drip irrigation systems supply water to the soil very slowly. Generally, they are very efficient in terms of both water and energy use and are suitable for use in vineyards and orchards.

Description: The soil properties and qualities important in the design and management of drip irrigation systems are soil depth, wetness or ponding, a need for drainage, and flooding. The soil properties and qualities that influence installation are soil depth, flooding, and ponding. The features that affect performance of the system and plant growth are the amount of salts, lime, gypsum, and sodium.

Reference Information:

Criteria were adjusted as requested by NRCS staff working on the Alameda County Agricultural Enhancement Plan.

The original interpretation was developed using input from the Davis, California NRCS - Resource Technology staff (Earth Team volunteer). The interpretation received further technical review from an irrigation specialist on staff at UC Davis.

References:

California Irrigation Guide. USDA-SCS. 1982. Developed in cooperation with the Pond-Shafter-Wasco Resource Conservation District.

Hanson, Blaine and Grattan, Stephen R. 1993. Agricultural Salinity and Drainage. University of California Irrigation Program. Univ. of California, Davis.

National Engineering Handbook. USDA-NRCS. Aug.1996. Part 652.

National Soil Survey Handbook. 1993. United States Department of Agriculture. Natural Resources Conservation Service: Part 620 - Soil Interpretations Rating Guides 620, Table 620-32.

The following is in the Description field in Rule table of a Child rule:

Depth to bedrock: Shallow depth to bedrock limits the soil's water holding capacity and the thickness of the root zone. Soil feature considered is the top depth of the first restrictive layer where restrictive type is "bedrock*". Depth to restrictive feature must be synchronized with the depth to the restrictive feature horizon shown in the horizon table.

Property used: "DEPTH TO BEDROCK (TX)" (Modality - representative value)

Restrictive limits:

Limiting	< 50cm
Not limiting	> = 50cm

Null depth is assigned to the Not limiting class.

The following is in the Description field in Evaluation table:

The evaluation checks for the presence of bedrock and if present indexes the depth. This index expresses the degree to which "depth to bedrock" is a limiting feature. Where "depth to bedrock" is:

< 50cm the soil is limited and the degree of limitation index is expressed as the number 1.0.
> = 50cm the soil is not limited and the degree of limitation index is expressed as the number 0.

The following is in the Description field in Property table:

Data used: resdept and reskind from component restriction table.

Consideration:
1. reskind imatches "bedrock*" and if true
2. resdepth

Logic: Reports the top depth of the first restrictive layer where kind equal bedrock. Depth to restrictive feature must be synchronized with the depth to the restrictive feature horizon shown in the horizon table.

Part 618 – SOIL PROPERTIES AND QUALITIES

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Part 618 - SOIL PROPERTIES AND QUALITIES

618.00 Definition and Purpose.

(a) Soil properties are measured or inferred from direct observations in the field or laboratory. Soil properties include, but are not limited to, particle-size distribution, cation exchange capacity, and salinity.

(b) Soil qualities are behavior and performance attributes that are not directly measured. They are inferred from observations of dynamic conditions and from soil properties. Soil qualities include, but are not limited to, corrosivity, natural drainage, frost action, and wind erodibility.

(c) Soil properties and soil qualities are the criteria used in soil interpretation rating guides, as predictors of soil behavior, and for classification and mapping of soils. The soil properties entered should be representative of the soil for the dominant land use for which interpretations will be based.

618.01 Policy and Responsibilities.

(a) Soil property data are collected, tested, and correlated as part of soil survey operations. These data are reviewed, supplemented, and revised as necessary.

(b) The soil survey project office is responsible for collecting, testing, and correlating soil property data and interpretive criteria.

(c) The MLRA office is responsible for the development, maintenance, quality assurance, correlation, and coordination of the collection of soil property data that are used as interpretive criteria. This includes all data elements listed in part 618.

(d) The National Soil Survey Center is responsible for the training, review, and periodic update of soil interpretation technologies.

(e) The state soil scientist is responsible for ensuring that the soil interpretations are adequate for the field office technical guide and that they meet the needs of federal, state, and local programs.

618.02 Collecting and Testing Soil Property Data.

The collection and testing of soil property data is based on the needs described in the soil survey memorandum of understanding for individual soil survey areas. The collection and testing must conform to the procedures and guides established in this handbook.

618.03 Soil Properties and Soil Qualities.

The following sections list soil properties and qualities in alphabetical order and provide some grouping for climatic and engineering properties and classes. A definition, classes, significance, method, and guidance for NASIS database entry are given. The listing includes the soil properties and qualities in the National Soil Information System. For specifics of data structure, attributes, and choices in NASIS, refer to http://nasis.nrcs.usda.gov/documents/metadata/5_1/

Previous databases of soil survey information used metric or English units for soil properties and qualities. The National Soil Information System (NASIS) transferred English units to metric units on conversion, except for crop yields in the database. All future edits and entries in NASIS will use metric units, except yields and acreage.

Ranges of soil properties and qualities, posted in the NASIS database for map unit components, may extend beyond the established limits of the taxon from which the component gets its name, but only to the extent that interpretations do not change. However, the representative value (RV) is within the range of the taxon.

618.04 Albedo, Dry.

(a) **Definition.** Albedo, dry, is the estimated ratio of the incident shortwave (solar) radiation that is reflected by the air-dry, less than 2 mm fraction of the soil surface to that received by it.

(b) **Significance.** Soil albedo, as a function of soil color and angle of incidence of the solar radiation, depends on the inherent color of the parent material, organic matter content, and weathering conditions.

Estimates of the evapotranspiration rates and for predicting soil water balances require the albedo. Evapotranspiration and soil hydrology models that are part of Water Quality and Resource Assessment programs require this information.

(c) **Measurement.** Instruments exist that measure albedo.

(d) **Estimation.** Approximate the values by use of the following formula:

Soil Albedo=0.069 x (Color Value} - 0.114.

For albedo, dry, use dry color value. Surface roughness has a separate significant impact on the actual albedo. The equation above is the albedo of <2.0 mm smoothed soil condition, but if the surface is rough because of tillage, the albedo differs.

(e) **Entries.** Enter the high, low, and representative values of the map unit component using the above formula. Allowable entries range from 0.00 to 1.00, with 2 decimal places.

618.05 Available Water Capacity.

(a) **Definition.** Available water capacity is the volume of water that should be available to plants if the soil, inclusive of fragments, were at field capacity. It is commonly estimated as the amount of water held between field capacity and wilting point, with corrections for salinity, fragments, and rooting depth.

(b) **Classes.** Classes of available water capacity are not normally used except as adjective ratings that reflect the sum of available water capacity in inches to some arbitrary depth. Class limits vary according to climate zones and the crops commonly grown in the areas. The depth of measurement also is variable.

(c) **Significance.** Available water capacity is an important soil property in developing water budgets, predicting droughtiness, designing and operating irrigation systems, designing drainage systems, protecting water resources, and predicting yields.

(d) Estimates. The most common estimates of available water capacity are made in the field or the laboratory as follows:

(1) Field capacity is determined by sampling the soil moisture content just after the soil has drained following a period of rain and humid weather, after a spring thaw, or after heavy irrigation. The Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, provides more information.

(2) The 15-bar moisture content of the samples is determined with pressure membrane apparatus.

(3) An approximation of soil moisture content at field capacity is commonly made in the laboratory using 1/3-bar moisture percentage for clayey and loamy soil materials and 1/10-bar for sandy materials. Recently, some soil physicists have been using 1/10-bar instead of 1/3-bar for clayey and loamy soil materials and 1/20-bar for sandy soil materials.

(4) Measure the bulk density of the moist soil. The Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, provides more information.

(5) Calculate available water capacity (AWC) using the following formula:

$$AWC = W_{1/3} - W_{15}) \times (Db_{1/3}) \times cm \ / 100$$

Where

AWC = volume of water retained in 1 cm^3 of whole soil between 1/3-bar and 15-bar tension; reported as $cm\ cm^{-1}$, i.e., numerically equivalent to inches of water per inch of soil (in in^{-1})

$W_{1/3}$ = weight percentage of water retained at 1/3-bar tension

W_{15} = weight percentage of water retained at 15-bar tension

$Db_{1/3}$ = bulk density of <2-mm fabric at 1/3-bar tension

$$Cm = \frac{\text{Vol moist <2-mm fabric (cm3)}}{\text{Vol moist whole soil (cm3)}}$$

Procedure 3B2 is used to determine Vol moist <2-mm fabric (cm^3).

AWC ($cm\ cm^{-1}$ or in in^{-1} horizon) = AWC ($cm\ cm^{-1}$ or in in^{-1}) X horizon thickness

(6) If data are available, estimates are based on available water capacity measurements. If data are not available, data from similar soils are used as a guide. The relationship between available water capacity and other soil properties has been studied by many researchers. Soil properties that influence available water capacity are particle size; size, shape, and distribution of pores; organic matter; type of clay mineral; and structure.

(7) amount of water available to plants is nearly zero. Available water capacity values are zero for layers that exclude roots. If roots are restricted but not excluded, estimates of available water capacity are reduced according to the amount of dense material in the layers and the space available for root penetration. Depending on the ability of roots to enter the soil mass and utilize the water, values for the soils with these dense layers may be significantly less than for soils of similar texture that do not have pans. Entries are made for all soil layers below dense layers only if roots are present.

(8) Depending on their abundance and porosity, rock and pararock fragments reduce available water capacity. Nonporous fragments reduce available water capacity in proportion to the volume they occupy, for example, 50 percent nonporous cobbles reduces available water capacity as much as 50 percent. Porous fragments, such as sandstone, may reduce available water capacity to a lesser proportion.

(9) Several factors contribute to a lower amount of plant growth on saline soils. However, as a rough guide, available water capacity is reduced by about 25 percent for each 4 mmhos cm-1 electrolytic conductivity of the saturated extract.

(10) Soils high in gibbsite or kaolinite, such as Oxisols and Ultisols, may have available water capacity values that are about 20 percent lower than those with equal amounts of 2:1 lattice clays.

(11) Soils high in organic matter have higher available water capacity than soils low in organic matter if the other properties are the same.

(e) **Entries**. Enter high, low, and representative values for available water capacity in cm per cm for each horizon. Enter "0" for layers that exclude roots. The range of valid data entries is 0.00 to 0.70 cm per cm.

618.06 Bulk Density, One-Tenth Bar or One-Third Bar.

(a) **Definition.** Bulk density one-tenth bar or one-third bar is the oven-dried weight of the less than 2 mm soil material per unit volume of soil at a water tension of 1/10 bar or 1/3 bar.

(b) **Significance.** Bulk density influences plant growth and engineering applications. It is used to convert measurements from a weight basis to a volume basis. Within a family particle size class, bulk density is an indicator of how well plant roots are able to extend into the soil. Bulk density is used to calculate porosity.

(1) Plant growth. Bulk density is an indicator of how well plant roots are able to extend into the soil. Root restriction initiation and root limiting bulk densities are shown below for various family particle size classes.

Family particle-size	**Bulk density (g cm^{-3})**	
Classes	**Restriction- initiation**	**Root- limiting**
Sandy	1.69	>1.85
Loamy		
coarse-loamy	1.63	>1.80
fine-loamy	1.60	>1.78
coarse-silty	1.60	>1.79
fine-silty	1.54	>1.65
Clayey*		
35-45% clay	1.49	>1.58
>45% clay	1.39	>1.47

* Oxidic and andic materials can initiate restriction at lower bulk densities.

(2) Engineering applications. Soil horizons with bulk densities less than those indicated below have low strength and would be subject to collapse if wetted to field capacity or above without loading. They may require special designs for certain foundations.

Family particle-size	**Bulk density (g cm^{-3})**
Sandy	<1.60
Loamy	
coarse-loamy	<1.40
fine-loamy	<1.40
coarse-silty	<1.30
fine-silty	<1.40
Clayey	<1.10

(c) Estimates. The weight applies to the oven-dry soil, and the volume applies to the soil at or near field capacity. For non-expansive soils, the 1/10-bar and 1/3-bar bulk densities are the same. Bulk density is a use dependent property. The entry should represent the dominant use for the soil.

(d) Entries. Enter bulk density at one tenth bar or one third bar with the low, high, and representative values for each horizon. The range of valid entries is 0.02 to 2.60 g cm-3. Values should be estimated to the nearest 0.05 g cm-3.

618.07 Bulk Density, 15 Bar.

(a) Definition. Bulk density 15 bar ($\rho b1500$) is the oven dry mass per unit volume of the <2 mm soil material at 15 bar water tension.

(b) Significance. Bulk density 15 bar is used in resource assessment models such as water erosion prediction.

(c) Estimation. The value is derived by equation 1.

EQUATION 1

$$\rho b_{1500} = \rho b_{33(10)} + \left[\left(\rho b_{od} - \rho b_{33(10)} \right) \times \left(\frac{\theta_{m33(10)} - \theta_{m1500}}{\theta_{m33(10)} - \theta_{mad}} \right) \right]$$

where:

$\rho b_{33\,(10)}$.... Bulk density at one-third bar (33kPa) or one-tenth bar (10kPa) moisture content, acquired from lab data, by direct field measurement (e.g., core samples, compliant cavity), or estimated from lab data of similar soils.

ρb_{od}.......... Bulk density at oven-dry moisture content, acquired from lab data, by direct field measurement (e.g., core samples, compliant cavity), estimated from lab data of similar soils, or derived by the equation given in NSSH 618.08.

$\Theta_{m33\,(10)}$... Gravimetric water content at one-third bar or one-tenth bar, in weight percent, from lab data, estimated from lab data of similar soils, or derived from equation 2.

EQUATION 2

$$\theta_{m33(10)} = \frac{MRD \times 100}{\rho b_{33(10)} + \left(1 - \frac{V_{>2mm}}{100}\right)} + \theta_{m1500}$$

where:
MRD... Moisture retention difference, derived from equation 3.

EQUATION 3 $$MRD = (\theta_{m33(10)} - \theta_{m1500})*100/\rho_{b33(10)}.$$

$\rho b_{33\,(10)}$...Bulk density at one-third bar (33kPa) or one-tenth bar (10kPa) moisture content, acquired from lab data, by direct field measurement (e.g., core samples, compliant cavity), or estimated from lab data of similar soils.
$V_{>2mm}$......fraction greater than 2mm, percent by volume.

Θ_{m1500} Gravimetric water content at 15 bar, in percent by weight. Acquired from lab data, estimated from lab data of similar soils, or derived from equation 4.

where:
OM ....Organic matter, weight percent.

EQUATION 4

$$\theta_{m1500} = 0.4\,(\%clay)\left(1 - \frac{OM}{100}\right) + OM$$

Θ_{mad} ...... Air dry gravimetric water, in weight percent[1] Acquired from lab data, estimated from lab data of similar soils, or derived from equation 5.

where:
AD/OD ...Ratio of air-dry mass to oven-dry mass. Acquired from lab data, estimated

EQUATION 5

$$\theta_{mad} = 100\left(\frac{AD}{OD} - 1\right)$$

from lab data of similar soils, or derived from equation 6.

[1] The rationale for using an air-dry moisture value (*AD/OD*) is that it is a fudge factor. It is based on the assumption of a direct straight line relationship between bulk density and water content, and so the equation given here describes volume change (1/Db) as a function of moisture content. The actual relationship is not a straight line. As moisture content decreases, particularly as it approaches oven dry, the relationship is curved. In the National Soil Survey Laboratory, the air-dry moisture is a point on the moisture line. Using air-dry moisture instead of oven-dry (0%) in the equation adjusts upward the 15 bar bulk density. The fudge factor changes the value in the proper direction, but is likely not the correct magnitude.

EQUATION 6

$$\frac{AD}{OD}=\frac{(0.1\,(\%clay))+(0.2\,(\%OM))+100}{100}$$

(d) Entries. Enter the high, low, and representative value for each horizon. Valid entries range from 0.02 to 2.60 and 2 decimal places are allowed.

618.08 Bulk Density, oven dry.

(a) Definition. Bulk density oven dry (Pb_{od}) is the oven dry weight of the less than 2 mm soil material per unit volume of oven-dry soil.

(b) Estimation. The value Pb_{od} is derived by the following formula:

Pb_{od} = [(linear extensibility percent/100) + 1]^3

where linear extensibility percent is adjusted to a <2 mm basis.

(c) Entries. Enter the high, low, and representative value for each horizon. Valid entries range from 0.02 to 2.60 and 2 decimal places are allowed.

618.09 Calcium Carbonate Equivalent.

(a) Definition. Calcium carbonate equivalent is the quantity of carbonate (CO3) in the soil expressed as CaCO3 and as a weight percentage of the less than 2 mm size fraction.

(b) Significance. The availability of plant nutrients is influenced by the amount of carbonates in the soil. This is a result of the effect that carbonates have on soil pH and of the direct effect that carbonates have on nutrient availability. Nitrogen fertilizers should be incorporated into calcareous soils to prevent nitrite accumulation or ammonium-N volatilization. The availability of phosphorus and molybdenum is reduced by the high levels of calcium and magnesium which are associated with carbonates. In addition, iron, boron, zinc, and manganese deficiencies are common in soils that have a high calcium carbonate equivalent. In some climates, soils that have a high calcium carbonate equivalent in the surface layer are subject to wind erosion. This effect may occur in soils that have a calcium carbonate equivalent of more than 5 percent. Strongly or violently effervescent reaction to cold dilute HCL defines calcareous in the wind erodibility groups because of the significance of finely divided carbonates.

(c) Measurement. Calcium carbonate equivalent is measured by method 6E1 as outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS. It also may be measured in the field using calcimeters.

(d) Entries. Enter the high, low, and representative values for each horizon listed. Round values to the nearest 5 percent for horizons that have more than 5 percent CaCO3 and to the nearest 1 percent for those with less than 5 percent. Enter 0 if the horizon does not have free carbonates.

618.10 Cation Exchange Capacity NH4OAc pH7.

(a) Definition. Cation-exchange capacity is the amount of exchangeable cations that a soil can adsorb at pH 7.0.

(b) Significance. Cation-exchange capacity is a measure of the ability of a soil to retain cations, some of which are plant nutrients. Soils that have a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils that have a high cation-exchange capacity. Soils that have high cation-exchange capacity have the potential to retain cations, which reduces the risk of the pollution of ground water.

(c) Measurement. Cation-exchange capacity is measured by the methods outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004. The ammonium acetate method 5A8 gives the cation-exchange capacity value for soils that have pH >5.5 or contain soluble salts. Cation-exchange capacity is expressed in milliequivalents per 100 grams (me 100g-1), of soil. If the pH is less than 5.5, use effective cation-exchange capacity (refer to part 618.18).

(d) Entries. Enter the high, low, and representative values of the estimated range in cation exchange capacity, in meq 100g-1, for each horizon with pH >5.5. Values in tenths are allowed. Valid entries range from 0.0 to 400.0.

618.11 Climatic Setting.

Climatic setting includes frost free period, precipitation, temperature, and evaporation. These elements are useful in determining the types of natural vegetation or crops that grow or can grow in an area and in planning management systems for vegetation. Climatic data are observed nationally by the National Weather Service Cooperative Network, which consists of approximately 10,000 climate stations. The records are available from the Climatic Data Access Facility (CDAF) at Portland, Oregon. Climatic data are delivered to the field through a Climatic Data Access Network. The Climatic Data Access Network consists of climatic data liaisons established in each state and at National Headquarters. Climatic data that are input into NASIS are obtained from the respective climatic data liaison. Climatic data may also be obtained from project weather stations or from the state climatologist. NRCS has selected the standard "normal" period of 1971 to 2000 for climate database entries. Always check with your state's climatic data liaison before using a climate station that has less than 30 years of records or that is located outside a county. Footnote the source of the data, the station, and the starting and ending year of record. Means are given as a range to represent the change of the climate over the geographic extent of the assigned soil.

(a) Frost-Free Period.

(1) Definition. Frost-free period is the expected number of days between the last freezing temperature (0° C) in spring (January-July) and the first freezing temperature (0° C) in fall (August-December). The number of days is based on the probability that the values for the standard "normal" period of 1971 to 2000 will be exceeded in 5 years out of 10.

(2) Entries. Enter the high, low, and representative values for the map unit component. Enter 365 for each value for taxa that are frost-free all year and 0 for those that have no frost-free period. Entries are rounded to the nearest 5 days.

(b) Precipitation, Mean Annual.

(1) Definition. Mean annual precipitation is the arithmetic average of the total annual precipitation taken over the standard "normal" period, 1971-2000. Precipitation refers to all forms of water, liquid or solid, that fall from the atmosphere and reach the ground.

(2) **Entries**. Enter the high, low, and representative values in millimeters of water, as integers to represent the spatial range for the map unit component.

(c) **Air Temperature, Mean Annual.**

(1) **Definition**. Mean annual air temperature is the arithmetic average of the daily maximum and minimum temperatures for a calendar year taken over the standard "normal" period, 1971-2000.

(2) **Entries**. Enter the high, low, and representative values as integers for the map unit component to represent the spatial range in degrees centigrade. Use a minus sign to indicate below zero temperatures.

(d) **Daily Average Precipitation.**

(1) **Definition.** Daily average precipitation is the total precipitation for the month divided by the number of days in the month for the standard "normal" period, 1971-2000.

(2) **Entries**. Enter the high, low, and representative value in mm. The range of allowed entries is 0 to 750 mm.

(e) **Daily Average Potential Evapotranspiration**

(1) **Definition.** Daily average potential evapotranspiration is the total monthly potential evapotranspiration divided by the number of days in the month for the standard "normal" period, 1971-2000.

(2) **Entries.** Enter the high, low, and representative value in mm. The range of allowed entries is 0 to 300 mm.

618.12 Corrosion.

Various metals and other materials corrode when they are on or in the soil, and some metals and materials corrode more rapidly when in contact with specific soils than when in contact with others. Corrosivity ratings are given for two of the common structural materials, uncoated steel and concrete.

(a) **Uncoated steel.**

(1) **Definition**. Risk of corrosion for uncoated steel is the susceptibility of uncoated steel to corrosion when in contact with the soil.

(2) **Classes.** The risk of corrosion classes are low, moderate, and high.

(3) **Significance**. Risk of corrosion on uncoated steel pertains to the potential soil-induced electrochemical or chemical action that converts iron into its ions, thereby dissolving or weakening uncoated steel.

(4) **Guides**. Exhibit 618-1 gives the relationsip of soil moisture, soil texture, acidity, and content of soluble salts (as indicated by either electrical resistivity at field capacity or electrolytic conductivity of the saturated extract of the soil) to corrosion classes.

(i) Soil reaction (pH) correlates poorly with corrosion potential; however, a pH of 4.0 or less almost always indicates a high corrosion potential.

(ii) Ratings, which are based on a single soil property or quality, that place soils in relative classes for corrosion potential must be tempered by knowledge of other properties and qualities that affect corrosion. A study of soil properties in relation to local experiences with corrosion helps soil scientists and engineers to make soil interpretations. Special attention should be given to those soil properties that affect the access of oxygen and moisture to the metal, the electrolyte, the chemical reaction in the electrolyte, and the flow of current through the electrolyte. A constant watch should be maintained for the presence of sulfides or of minerals, such as pyrite, that can be weathered readily and thus cause a high degree of corrosion in metals.

(iii) The possibility of corrosion is greater for extensive installations that intersect soil boundaries or soil horizons than for installations that are in one kind of soil or in one soil horizon.

(iv) Using interpretations for corrosion without considering the size of the metallic structure or the differential effects of using different metals may lead to wrong conclusions. Activities, such as construction, paving, fill and compaction, and surface additions, that alter the soil can increase possibility of corrosion by creating an oxidation cell that accelerates corrosion. Mechanical agitation or excavation that results in aeration and in a discontinuous mixing of soil horizons may also increase the possibility of corrosion.

(5) **Entries.** Enter the appropriate class of risk of corrosion for uncoated steel for the whole soil. The classes are LOW, MODERATE, or HIGH.

(b) Concrete.

(1) **Definition.** Risk of corrosion for concrete is the susceptibility of concrete to corrosion when in contact with the soil.

(2) **Classes.** The risk of corrosion classes are low, moderate, and high.

(3) **Significance**. Risk of corrosion on concrete pertains to the potential soil-induced chemical reaction between a base (the concrete) and a weak acid (the soil solution). Special cements and methods of manufacturing may be used to reduce the rate of deterioration in soils that have a high risk of corrosion. The rate of deterioration depends on (i) soil texture and acidity, (ii) the amount of sodium or magnesium sulfate present in the soil, singly or in combination, and (iii) the amount of sodium chloride (NaCl) in the soil. The presence of NaCl is one of the factors evaluated not because of its corrosivity of cement but because it is used to identify the presence of seawater. Seawater contains sulfates, which are one of the principal corrosive agents. A soil that has gypsum requires special cement. The calcium ions in gypsum react with the cement and weaken the concrete.

(4) **Guides.** Exhibit 618-2 gives the relationship of soil texture, soil acidity, sulfates, and NaCl to corrosion classes.

(5) **Entries**. Enter the appropriate class of risk of corrosion for concrete for the whole soil. The classes are LOW, MODERATE, or HIGH.

618.13 Crop Name and Yield.

(a) Definition. Crop name is the common name for the crop. Crop yield units is crop yield units per unit area for the specified crop.

(b) Classes. The crop names and the units of measure for yields that are allowable as data entries are listed in the data dictionary of the National Soil Information System. (http://nasis.nrcs.usda.gov/documents/metadata/4_1/home.shtml).

(c) Significance. Crop names and units of measure are important as records of crop yield. The crops and yield often are specific to the time when the soil survey was completed, but the ranking and comparison between soils within a soil survey is helpful. These crops and yield data are used to evaluate the soil productive capabilities, cash rent, and land values. Generally, only the most important crops are listed and only the best management is reflected.

(d) Estimates. Crop names and yields are specific to the soil survey area. The listing of crop names is not limited to any number but only the most important crops in the survey area should be used. The yields are derived in a number of ways but should represent a high level of management by leading commercial farmers, which tends to produce the highest economic return per acre. This level of management includes using the best varieties; balancing plant populations and added plant nutrients to the potential of the soil; controlling erosion, weeds, insects, and diseases; maintaining optimum soil tilth; providing adequate soil drainage; and ensuring timely operations.

Generally only a representative value is used for each map unit component for non MLRA soil survey areas. MLRA soil survey areas use the high and low representative value from map unit components of non MLRA soil survey areas. High and low values represent the range of representative values for a high level of management across the survey area or across several surveys.

(e) Entries. Enter the common crop name and units of measure. Enter the corresponding irrigated and/or nonirrigated yields as appropriate for the component. Yields can be posted as high, low, and representative values for the map unit component.

618.14 Diagnostic Horizon Feature Depth to Bottom.

(a) Definition. Diagnostic horizon feature depth to bottom is the distance from the top of the soil to the base of the identified diagnostic horizon or to the lower limit of the occurrence of the diagnostic feature.

(b) Measurement. Distance is measured from the top of the soil which is defined as the top of the mineral soil, or, for soils with "O" horizons, the top of any "O" layer that is at least partially decomposed. For soils that are covered by 80 percent or more rock or pararock fragments, the top of the soil is the surface of the fragments. See pages 63-64 in the Soil Survey Manual for a complete discussion.

(c) Entries. Enter the high, low, and representative values in whole centimeters. The high value represents either the greatest depth to which the base of the diagnostic horizon or feature extends or, for horizons for features extending beyond the limit of field observation, it is the depth to which observation was made (usually no more than 200 cm). In the case of the lithic contact, paralithic contact, and petroferric contact, the entries for depth to the bottom of the diagnostic feature will be the same as the entries for depth to the top of the feature, since the contact has no thickness.

618.15 Diagnostic Horizon Feature Depth to Top.

(a) Definition. Diagnostic horizon feature depth to top is the distance from the top of the soil to the upper boundary of the identified diagnostic horizon or to the upper limit of the occurrence of the diagnostic feature.

(b) Measurement. Distance is measured from the top of the soil, which is defined as the top of the mineral soil, or, for soils with "O" horizons, the top of any "O" layer that is at least partially decomposed. For soils that are covered by 80 percent or more rock or pararock fragments, the top of the soil is the surface of the fragments. See pages 63-64 in the Soil Survey Manual for a complete discussion.

(c) Entries. Enter the high, low, and representative values in whole centimeters.

618.16 Diagnostic Horizon Feature Kind.

(a) Definition. Diagnostic horizon feature kind is the kind of diagnostic horizon or diagnostic feature present in the soil.

(b) Significance. Diagnostic horizons and features are a particular set of observable or measurable soil properties that are used in Soil Taxonomy to classify a soil. They have been chosen because they are thought to be the marks left on the soil as a result of the dominant soil forming processes. In many cases they are thought to occur in conjunction with other important accessory properties. The utilization of diagnostic horizons and features in the classification process allows the grouping of soils that have formed as a result of similar genetic processes. The grouping, however, is done on the basis of observable or measurable properties, rather than speculation about the genetic history of a particular soil.

(c) Entries. The diagnostic horizons and features are listed in the latest Keys to Soil Taxonomy. Allowable codes are given in the NASIS data dictionary.

618.17 Drainage Class.

(a) Definition. Drainage class identifies the natural drainage condition of the soil. It refers to the frequency and duration of wet periods.

(b) Classes. The seven natural drainage classes are: (1) excessively drained, (2) somewhat excessively drained, (3) well drained, (4) moderately well drained, (5) somewhat poorly drained, (6) poorly drained, and (7) very poorly drained. Chapter 3 of the Soil Survey Manual provides a description of each natural drainage class.

(c) Significance. Drainage classes provide a guide to the limitations and potentials of the soil for field crops, forestry, range, wildlife, and recreational uses. The class roughly indicates the degree, frequency, and duration of wetness, which are factors in rating soils for various uses.

(d) Estimates. Infer drainage classes from observations of landscape position and soil morphology. In many soils the depth and duration of wetness relate to the quantity, nature, and pattern of redoximorphic features. Correlate drainage classes and redoximorphic features through field observations of water tables, soil wetness, and landscape position. Record the drainage classes assigned to the series.

(e) Entries. Enter the drainage class name for each map unit component. Utilize separate map unit components for different drainage class phases or for drained versus undrained phases where needed.

Drainage Class
Excessively
Somewhat excessively
Well
Moderately well
Somewhat poorly
Poorly
Very poorly

618.18 Effective Cation-Exchange Capacity

(a) Definition. Effective cation-exchange capacity is the sum of NH4OAc extractable bases plus KCl extractable aluminum (method 5A3b, SSIR #42).

(b) Significance. Cation exchange capacity is a measure of the ability of a soil to retain cations, some of which are plant nutrients. Soils that have a low cation exchange capacity hold fewer cations and may require more frequent applications of fertilizer and amendments than soils that have a high cation exchange capacity. Soils that have high cation exchange capacity have the potential to retain cations. Effective CEC is a measure of CEC that is particularly useful in soils whose ion exchange capacity is largely a result of variable charge components such as allophane, kaolinite, hydrous iron and aluminum oxides, and organic matter, which results in the soil's CEC being not a fixed number but a function of pH. Examples of such soils might include some andic soils, Oxisols, and more weathered Ultisols with kaolinitic mineralogy.

(c) Measurement. Effective cation exchange capacity is measured by the methods outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November, 2004. Method 5A3b gives the effective cation exchange capacity value for soils that have pH <5.5 and that are low in soluble salts. For soils that have a pH of 5.5 or greater, the ECEC equals the sum of NH4OAc extractable bases.

(d) Entries. Enter the high, low, and representative values of the estimated range in effective cation exchange capacity at the field pH of the soil, in meq 100g1, for the horizon. Values in tenths are allowed. Valid entries range from 0.0 to 400.0.

618.19 Electrical Conductivity.

(a) Definition. Electrical conductivity is the electrolytic conductivity of an extract from saturated soil paste.

(b) Classes. The classes of salinity are:

Classes	**Electrical Conductivity (mmhos cm $^{-1}$)**
Nonsaline	0-2
Very slightly saline	≥2-4
Slightly saline	≥4-8
Moderately saline	≥8-16
Strongly saline	≥16

(c) Significance. Electrical conductivity is a measure of the concentration of water-soluble salts in soils. It is used to indicate saline soils. High concentrations of neutral salts, such as sodium chloride and sodium sulfate, may interfere with the absorption of water by plants because the osmotic pressure in the soil solution is nearly as high or higher than that in the plant cells. Salts may also interfere with the exchange capacity of nutrient ions, thereby resulting in nutritional deficiencies in plants.

(d) Measurement. The electrolytic conductivity of a saturated extract is the standard measure used to express salinity as millimhos per centimeter (mmhos cm^{-1}) at 25 degrees C. The laboratory procedure used to measure is described in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(e) Estimates. Field estimates of salts are made from observations of free salt on structural faces or on the soil surface, from plant growth indicators, or from field salinity meters. The occurrences of bare spots, salt-tolerant plants, and uneven crop growth are used as indicators of salinity and high electrical conductivity. When keyed to measurements, these observations help to estimate the amount of salts.

(f) Entries. Enter the high, low, and representative values for the range of electrolytic conductivity of the saturation extract during the growing season for each horizon. Use the following classes: 0-2, 2-4, 4-8, 8-16, and 16-32; or use a combination of classes, for example, 2-8 for the high and low values. The allowable range is 0 to 99.

618.20 Elevation.

(a) Definition. Elevation is the vertical distance from mean sea level to a point on the earth's surface.

(b) Significance. Elevation, or local relief, exerts a modifying influence of the genesis of natural soil bodies. Elevation also may affect soil drainage within a landscape, salinity or sodicity within a climatic area, or soil temperature.

(c) Estimates. Elevation is normally obtained from U.S. Geological Survey topographic maps or measured using altimeters or global positioning systems.

(d) Entries. Enter the high, low, and representative values for each map unit component. The minimum entry is -300 meters and the maximum entry is 8550 meters. Record elevation to the nearest integer.

618.21 Engineering Classification.

(a) AASHTO group classification.

(1) **Definition**. AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82 and consists of a symbol and a group index. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

(2) **Classes**. The AASHTO classification system identifies two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications. Exhibit 618-4 shows the criteria for classifying soil in the AASHTO classification system.

The group and subgroup classifications are based on estimated or measured grain-size distribution and on liquid limit and plasticity index values.

(3) **Significance**. The group and subgroup classifications of this system are aids in the evaluation of soils for highway and airfield construction. The classifications can help to make general interpretations relating to performance of the soil for engineering uses, such as highways and local roads and streets.

(4) **Measurements**. Measurements involve sieve analyses for the determination of grain-size distribution of that portion of the soil between a 3 inch and 0.074 mm particle size. ASTM methods D 422, C 136, and C 117 have applicable procedures for the determination of grain-size distribution. The liquid limit and plasticity index values (ASTM method D 4318) are determined for that portion of the soil having particles smaller than 0.425 mm in diameter (No. 40 sieve). Measurements, such as laboratory tests, are made on most benchmark soils and on other representative soils in survey areas.

(5) **Estimates**. During soil survey investigations and field mapping activities, the soil is classified by field methods. This classification involves making estimates of particle-size fractions by a percentage of the total soil, minus the greater than 3-inch fraction. Estimates of liquid limit and plasticity index are based on clay content and mineralogy relationships. Estimates are expressed in ranges that include the estimating accuracy as well as the range of values for the taxon.

(6) **Entries**. Enter classes and separate them by commas for each horizon, for example, A-7, A-6. Acceptable entries are A-1, A-1-A, A-1-B, A-2, A-2-4, A-2-5, A-2-6, A-2-7, A-3, A-4, A-5, A-6, A-7, A-7-5, A-7-6, and A-8.

(b) AASHTO group index.

(1) **Definition.** The AASHTO group and subgroup classifications may be further modified by the addition of a group index value. The empirical group index formula was devised for approximate within-group evaluation of the "clayey granular materials" and the "silty-clay" materials.

(2) **Significance.** The group index is an aid in the evaluation of the soils for highway and airfield construction. The index can help to make general interpretations relating to performance of the soil for engineering uses, such as highways and local roads and streets.

(3) Measurement. The group index is calculated from an empirical formula:

GI = (F-35) [0.2 + 0.005 (LL-40)] + 0.01 (F-15) (PI-10)

where:

F = Percentage passing sieve No. 200 (75 micrometer), expressed as a whole number

LL = Liquid limit

PI = Plasticity index

In calculating the group index of A-2-6 and A-2-7 subgroups, only the PI portion of the formula is used.

(4) Entries. The group index is reported to the nearest integer. If the calculated group index is negative, the group index is zero (0). The minimum index value is 0 and the maximum is 120.

(c) Unified soil classification.

(1) Definition. The unified soil classification system is a system for classifying mineral and organic mineral soils for engineering purposes based on particle-size characteristics, liquid limit, and plasticity index.

(2) Classes. The Unified Soil Classification System identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter, and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified Soil Classification System.

(3) Significance. The various groupings of this classification have been devised to correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

(4) Measurement. The methods for measurement are provided in ASTM Designation D 2487. Measurements involve sieve analysis for the determination of grain-size distribution of that portion of the soil between 3 inches and 0.074 mm in diameter (No. 200 sieve). ASTM methods D 422, C 136, and C 117 have applicable procedures that are used where appropriate for the determination of grain-size distribution. Values for the Atterberg limits (liquid limit and plasticity index) are also used. Specific tests are made for that portion of the soil having particles smaller than 0.425 mm in diameter (No. 40 sieve) according to ASTM methods D 423 and D 424. Measurements, such as laboratory tests, are made on most benchmark soils and on other representative soils in survey areas.

(5) Entries for measured data. For **measured** Unified data, enter up to four classes for each horizon. ASTM D 2487 provides flow charts for classifying the soils. Separate the classes by commas, for example, CL-ML, ML. Acceptable entries are GW, GP, GM, GC, SW, SP, SM, SC, CL, ML, OL, CH, MH, OH, PT, CL-ML, GW-GM, GW-GC, GP-GM, GP-GC, GC-GM, SW-SM, SW-SC, SP-SM, SP-SC, and SC-SM.

(6) **Estimates**. The methods for estimating are provided in ASTM Designation D 2488. During all soil survey investigations and field mapping activities, the soil is classified by field methods. The methods include making estimates of particle-size fractions by a percentage of the total soil. The Atterberg limits are also estimated based on the wet consistency, ribbon or thread toughness, and other simple field tests. These tests and procedures are explained in ASTM D 2488. If samples are later tested in the laboratory, adjustments are made to field procedures as needed. Estimates are expressed in ranges that include the estimating accuracy as well as the range of values from one location to another within the map unit. If an identification is based on visual-manual procedures it must be clearly stated so in reporting.

(7) **Entries for estimated soils**. For **estimated** visual-manual Unified data, enter up to four classes for each horizon. ASTM D 2488 provides flow charts for classifying the soils. Separate the classes by commas, for example, CL, ML, SC. Acceptable entries are GW, GP, GM, GC, SW, SP, SM, SC, CL, ML, CH, MH, OL/OH, PT, GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, and SP-SC.

618.22 Erosion Accelerated, Kind.

(a) **Definition**. Erosion accelerated, kind, is the type of detachment and removal of surface soil particles as largely affected by human activity.

(b) **Significance**. The type of accelerated erosion is important in assessing the current health of the soil, and in assessing its potential for different uses. Erosion, whether natural or induced by humans, is an important process that affects soil formation and may remove all or parts of the soils formed in the natural landscape.

(c) **Classes**.

Accelerated erosion Class
Water erosion, sheet
Water erosion, rill
Water erosion, gully
Water erosion, tunnel
Wind erosion

(d) **Entries**. Enter the appropriate class for each map unit component. Multiple entries are allowable, but a representative value should be indicated.

618.23 Erosion Class.

(a) **Definition.** Erosion class is the class of accelerated erosion.

(b) **Significance.** The degree of erosion that has taken place is important in assessing the health of the soil and in assessing the soil's potential for different uses. Erosion is an important process that affects soil formation and may remove all or parts of the soils formed in natural landscapes.

Removal of increasing amounts of soil increasingly alters various properties and capabilities of the soil. Properties and qualities affected include bulk density, organic matter content, tilth, water infiltration. Altering these properties affects the productivity of the soil.

(c) Estimation. During soil examinations, estimate the degree to which soils have been altered by accelerated erosion. The Soil Survey Manual describes the procedures involved.

(d) Classes.

Erosion Class
none - deposition
Class 1
Class 2
Class 3
Class 4

(e) Entries. Enter the appropriate class for each map unit component.

618.24 Excavation Difficulty Classes.

(a) Definition. Excavation difficulty is an estimation of soil layers, horizons, pedons, or geologic layers according to the difficulty in making an excavation into them. Excavation difficulty, in most instances, is strongly controlled by water state, which should be specified.

(b) Classes. The excavation difficulty classes are:

Classes	Definition
Low	Excavations can be made with a spade using arm-applied pressure only. Neither application of impact energy nor application of pressure with the foot to a spade is necessary
Moderate	Arm-applied pressure to a spade is insufficient. Excavation can be accomplished quite easily by application of impact energy with a spade or by foot pressure on a spade.
High	Excavation with a spade can be accomplished with difficulty. Excavation is easily possible with a full length pick, using an over-the-head swing.
Very high	Excavation with a full length pick, using an over-the-head swing, is moderately to markedly difficult. Excavation is possible in a reasonable period of time with a backhoe mounted on a 40 to 60 kW (50-80 hp) tractor
Extremely high	Excavation is nearly impossible with a full length pick using an over-the-head arm swing. Excavation cannot be accomplished in a reasonable time period with a backhoe mounted on a 40 to 60 kW (50-80 hp) tractor

(c) Significance. Excavation difficulty classes are important for evaluating the cost and time needed to prepare shallow excavations.

(d) Estimates. Estimates of excavation difficulty classes are made from field observations.

(e) Entries. Enter the appropriate class for each horizon. The allowable entries are Low, Moderate, High, Very high, and Extremely high.

618.25 Extractable Acidity.

(a) Definition. Extractable acidity is a measure of soil exchangeable hydrogen ions that may become active by cation exchange.

(b) Significance. Extractable acidity is important for soil classification and for certain evaluations of soil nutrient availability or of the effect of waste additions to the soil.

(c) Measurement. Extractable acidity is determined by method 6H5a, as outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) Entries. Enter the range of extractable acidity as milliequivalents per 100 grams (meq 100g-1) of soil for the horizon. Valid entries range from 0.0 to 250.0. Tenths are allowed.

618.26 Extractable Aluminum.

(a) Definition. Extractable aluminum is the amount of aluminum extracted in one normal potassium chloride.

(b) Significance. Extractable aluminum is important for soil classification and for certain evaluations of soil nutrient availability and of toxicities. An aluminum saturation of about 60 percent is usually regarded as toxic to most plants. It may be a useful measurement for assessing potential lime needs for acid soils.

(c) Measurement. Extractable aluminum is determined by method 6G9d, as in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS. Units of measure are milliequivalents per 100 grams (meq 100g-1).

(d) Entries. Enter the range of extractable aluminum as milliequivalents per 100 grams (meq 100g-1) of soil for the horizon. Valid entries range from 0.0 to 150.0. Tenths are allowed.

618.27 Flooding Frequency, Duration, and Month.

(a) Definition. Flooding is the temporary covering of the soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources. Shallow water standing or flowing that is not concentrated as local runoff during or shortly after rain or snow melt is excluded from the definition of flooding. Chapter 3 of the Soil Survey Manual provides additional information. Standing water (ponding) or water that forms a permanent covering is also excluded from the definition.

(b) Classes. Estimates of flooding class are based on the interpretation of soil properties and other evidence gathered during soil survey field work. Flooding hazard is expressed by (1) flooding frequency class, (2) flooding duration class, and (3) time of year that flooding occurs. Not considered here, but nevertheless important, are velocity and depth of floodwater. Frequencies used to define classes are generally estimated from evidence related to the soil and vegetation. They are expressed in wide ranges that do not indicate a high degree of accuracy. Flooding frequencies that are more precise can be calculated by performing complex analyses used by engineers. The class very frequent is intended for use on areas subject to daily and monthly high tides.

(1) **Flooding frequency class**. Flooding frequency class is the number of times flooding occurs over a period of time and expressed as a class. The classes of flooding are defined as follows:

Class	Definition
None	No reasonable possibility of flooding; near 0 percent chance of flooding in any year or less than 1 time in 500 years.
Very Rare	Flooding is very unlikely but possible under extremely unusual weather conditions; less than 1 percent chance of flooding in any year or less than 1 time in 100 years but more than 1 time in 500 years.
Rare	Flooding unlikely but possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years
Occasional	Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years
Frequent	Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year or more than 50 times in 100 years, but less than a 50 percent chance of flooding in all months in any year.
Very Frequent	Flooding is likely to occur very often under usual weather conditions; more than a 50 percent chance of flooding in all months of any year.

(2) **Flooding duration classes**. The average duration of inundation per flood occurrence is given only for occasional, frequent, and very frequent classes.

Class	Duration
Extremely brief	0.1 to 4.0 hours
Very brief	4 to 48 hours
Brief	2 to 7 days
Long	7 days to 30 days
Very long	≥30 days

(3) **Assignment**. Yearly flooding frequency classes are assigned to months to indicate the months of occurrence and not the frequency of the flooding during the month, except for the very frequent class. The time period expressed includes two-thirds to three-fourths of the occurrences. Time period and duration of the flood are the most critical factors that determine the growth and survival of a given plant species. Flooding during the dormant season has few if any harmful effects on plant growth or mortality and may improve the growth of some species. If inundation from flood water occurs for long periods during the growing season, the soil becomes oxygen deficient and plants may be damaged or killed.

(c) **Significance**. The susceptibility of soils to flooding is an important consideration for building sites, sanitary facilities, and other uses. Floods may be less costly per unit area of farmland as compared to that of urban land, but the loss of crops and livestock can be disastrous.

(d) **Estimates**. The most precise evaluation of flood-prone areas for stream systems is based on hydrologic studies. The area subject to inundation during a flood of a given frequency, such as one with a 1 percent or 2 percent chance of occurrence, generally is determined by one of two basic methods.

(1) The first method is used if stream flow data are available. In this method, the data are analyzed to determine the magnitude of floods of different frequencies. Engineering studies are made to

determine existing channel capacities and flow on the flood plain by the use of valley cross sections and water surface profiles.

(2) The second method is used if stream flow data are not available. In this method, hydrologists make an estimate of flood potential from recorded data on rainfall. They consider such factors as (i) size, slope, and shape of the contributing watershed, (ii) hydrologic characteristics of the soil, (iii) land use and treatment, and (iv) hydraulic characteristics of the valley and channel system.

(3) With the use of either method, soil surveys can aid in the delineation of flood-prone areas. Possible sources of flooding information are (i) NRCS project-type studies, such as PL 556, FP, RB, or RC&D; (ii) flood hazard analyses; (iii) Corps of Engineers flood plain information reports; (iv) special flood reports; (v) local flood protection and flood control project reports; (vi) HUD flood insurance study reports; (vii) maps by USGS, NRCS, TVA, COE, NOAA; (viii) studies by private firms and other units of government; and (ix) USGS quadrangle sheets and hydrologic atlases of flood-prone areas and stream gauge data.

(4) General estimates of flooding frequency and duration are made for each soil. However, in intensively used areas where construction has materially altered the natural water flow, flood studies are needed to adequately reflect present flooding characteristics.

(5) Soil scientists collect and record evidence of flood events during the course of the soil survey. The extent of flooded areas, flood debris in trees, damage to fences and bridges, and other signs of maximum water height are recorded. Information that is helpful in delineating soils that have a flood hazard is also obtained. Hydrologists may have flood stage predictions that can be related to kinds of soil or landscape features. Conservationists and engineers may have recorded elevations of high flood marks. Local residents may have recollections of floods that can help to relate the events to kinds of soil, topography, and geomorphology.

(6) Certain landscape features have developed as the result of past and present flooding and include former river channels, oxbows, point bars, alluvial fans, meander scrolls, sloughs, natural levees, backswamps, sand splays, and terraces. Most of these features are easily recognizable on aerial photographs by comparing the photo image with on-the-ground observations. Different kinds of vegetation and soils are normally associated with these geomorphic features.

(7) The vegetation that grows in flood areas may furnish clues to past flooding. In central and southeastern United States, the survival of trees in flood-prone areas depends on the frequency, duration, depth, and time of flooding and on the age of the tree.

(8) Past flooding may sometimes leave clues in the soil, such as (1) thin strata of material of contrasting color or texture, or both; (2) an irregular decrease in organic matter content, which is an indication of a buried surface horizon; and (3) soil layers that have abrupt boundaries to contrasting kinds of material, which indicate that the materials were laid down suddenly at different times and were from different sources or were deposited from stream flows of different velocities.

(9) Laboratory analyses of properly sampled layers are often helpful in verifying these observations. Organic carbon and particle-size analyses are particularly useful in verifying flood deposits. Microscopic observations may detect preferential horizontal orientation of plate-like particles; micro-layering, which indicates water-laid deposits; or mineralogical differences between layers.

(e) Entries. Flooding and frequency are posted for each month of the year for each map unit component. Flooding entries reflect the current existing and mapped condition with consideration for dams, levees, and other man-induced changes affecting flooding frequency and duration.

(1) Enter the flooding frequency class name: none, very rare, rare, occasional, frequent, or very frequent.

(2) Enter the flooding duration class name that most nearly represents the soil: extremely brief, very brief, brief, long, or very long.

618.28 Fragments in the Soil

(a) Definition. Fragments are unattached cemented pieces of bedrock, bedrock-like material, durinodes, concretions, and nodules 2 mm or larger in diameter; and woody material 20 mm or larger in organic soils. Fragments are separated into three types: rock fragments; pararock fragments, which are separated based on cementation; and wood fragments.

(1) Rock fragments are unattached pieces of rock 2 mm in diameter or larger that are strongly cemented or more resistant to rupture. Rock fragments from 2 mm to 75 mm (3 inches) are considered when estimating the percent passing sieves as discussed in part 618.44.

(2) Pararock fragments are unattached, cemented bodies or pieces of material 2 mm in diameter or larger that are extremely weakly cemented to moderately cemented. These fragments are not retained on sieves because of the sample preparation by grinding.

(3) Wood fragments are woody materials that cannot be crushed between the fingers when moist or wet and are larger than 20 mm in size. Wood fragments are only used in organic soils. They are comparable to rock and pararock fragments in mineral soils.

(b) Significance. The fraction of the soil 2 mm or larger has an impact on the behavior of the whole soil. Soil properties, such as available water capacity, cation exchange capacity, saturated hydraulic conductivity, structure, and porosity, are affected by the volume, composition, and size distribution of fragments in the soil. Fragments also affect the management of the soil and are used as interpretation criteria. Terms related to volume, size, and hardness of fragments are used as texture modifier terms.

Generally, the fraction of soil greater than 75 mm (3 inches) in diameter is not included in the engineering classification systems. However, it can be added as a descriptive term to the group name, for example, poorly graded gravel with silt, sand, cobbles, and boulders. Estimates of the percent of cobbles and boulders are presented in the soil descriptions for a group name. A small amount of these larger particles generally has little effect on soil properties. It may, however, have an effect on the use of a soil in certain types of construction. Often, the larger portions of a soil must be removed before the material can be spread in thin layers, graded, or compacted and graded to a smooth surface. As the quantity of this "oversized" fraction increases, the properties of the soil can be affected. If the larger particles are in contact with each other, the strength of the soil is very high and the compressibility very low. If voids exist between the larger particles, the soil will likely have high saturated hydraulic conductivity and may undergo some internal erosion as a result of the movement of water through the voids. Most of the smaller and more rapid construction equipment normally used in excavating and earthmoving cannot be used if the oversize fraction of a soil is significant.

(c) Measurement. The fraction from 2 to 75 mm may be measured in the field. However, 50-60 kg of sample may be necessary if an appreciable amount of fragments near 75 mm are present. An alternative is to visually estimate the volume of the 20-to 75-mm fraction, then sieve and weigh the 2-to 20-mm fraction. The fraction 75 mm (3 inches) or greater is usually not included in soil samples taken in the field for laboratory testing. Measurements can be made in the field by weighing the dry sample and the portion retained on a 3-inch screen. The quantity is expressed as a weight percentage of the total soil. A sample as large as 200 pounds to more than a ton may be needed to assure that the results are representative. Measurements of the fraction from 75 to 250 mm (3 to 10 inches) and the fraction greater than 250 mm (10 inches) are usually obtained from volume estimates.

(d) Estimates. Estimates are usually made by visual means and are on the basis of percent by volume. The percent by volume is converted to percent by weight, as shown in Exhibit 618-11, by using the average bulk unit weights for soil and rock. These estimates are made during investigation and mapping activities in the field. They are expressed as ranges that include the estimating accuracy as well as the range of values for a component.

Measurements or estimates of fragments less than strongly cemented are made prior to any rolling or crushing of the sample.

(e) Rock Fragments greater than 10 inches (250 mm).

(1) Definition. Rock fragment greater than 10 inches is the percent by weight of the horizon occupied by rock fragments greater than 10 inches (250 mm) in size. The upper limit is undefined, but for practical purposes it generally is no larger than a pedon, up to 10 meters square. For nonspherical material, the intermediate dimension is used for the 250 mm (10 inch) measurement. For example, a flat-shaped rock fragment that is 100 mm x 250 mm x 380 mm has an intermediate dimension of 250 mm, and is not counted as greater than 250 mm. A flat-shaped rock fragment that is 100 mm x 275 mm x 380 mm has an intermediate dimension of 275 mm, and is counted as greater than 250 mm.

(2) Entries. Enter the high, low, and representative values as whole number percentages for each horizon as appropriate.

(f) Rock fragments 3 to 10 inches (75 to 250 mm).

(1) Definition. Rock fragments 3 to 10 inches is the percent by weight of the horizon occupied by rock fragments 3 to 10 inches (75 to 250 mm) in size.

(2) Entries. Enter the high, low, and representative values as whole number percentages for each horizon as appropriate.

(g) Fragment kind.

(1) Definition. Fragment kind is the lithology/composition of the 2 mm or larger fraction of the soil.

(2) Entries. Enter the appropriate class name for the kind of fragment present. More than one choice may be entered. The class names can be found in the NASIS data dictionary.

(h) Fragment roundness.

(1) Definition. Fragment roundness is an expression of the sharpness of edges and corners of fragments.

(2) Significance. The roundness of fragments impacts water infiltration, root penetration, and macropore space.

(3) Classes. The fragment roundness classes are:

Roundness class
Angular
Subangular
Subrounded
Rounded
Well-rounded

(4) Entries. Enter the appropriate class name for the roundness class(es) present. A representative value may be designated.

(i) Fragment rupture resistance cemented.

(1) Definition. Fragment rupture resistance cemented is the rupture resistance of a fragment of specified size that has been air dried and then submerged in water.

(2) Measurements. Measurements are made using the procedures and classes of cementation that are listed with the rupture resistance classes in the Soil Survey Manual. Classes are described for block-like specimens about 25-30 mm on edge, which are air-dried and then submerged in water for at least 1 hour. The specimen is compressed between extended thumb and forefinger, between both hands, or between the foot and a nonresilient flat surface. If the specimen resists compression, a weight is dropped onto it from progressively greater heights until it ruptures. Failure is considered at the initial detection of deformation or rupture. Stress applied in the hand should be over a 1-second period. The tactile sense of the class limits may be learned by applying force to top loading scales and sensing the pressure through the tips of the fingers or through the ball of the foot. Postal scales may be used for the resistance range that is testable with the fingers. A bathroom scale may be used for the higher rupture resistance range.

(3) Significance. The rupture resistance of a fragment is significant where the class is strongly cemented or higher. These classes can impede or restrict the movement of soil water vertically through the soil profile and have a direct impact on the quality and quantity of ground water and surface water.

(4) Classes. The classes are:

Rupture resistance class
Extremely weakly
Very weakly
Weakly
Moderately
Strongly
Very strongly
Indurated

(5) Entries. Enter the appropriate class name(s) for the fragments present. A representative value may be designated.

(j) Fragment shape.

(1) **Definition**. Fragment shape is a description of the overall shape of the fragment.

(2) **Significance**. Fragment shape is important for fragments that are too large to be called channers or flagstones.

(3) **Classes**. The classes are:

Flat
Nonflat

(4) **Entries**. Enter the appropriate class name for the class(es) present. Multiple entries may be made. A representative value may be designated.

(k) Fragment size.

(1) **Definition**. Fragment size is the size based on the multiaxial dimensions of the fragment.

(2) **Significance**. The size of fragments is significant to the use and management of the soil. Fragment size is used as criteria for naming map units. It affects equipment use, excavation, construction, and recreational uses.

(3) **Classes**. Classes of fragment size are subdivided according to flat and non-flat fragments.

Flat fragment classes	Length (mm)
Channers	2-150
Flagstones	150-380
Stones	380-600
Boulders	≥ 600

Non-flat fragment classes	Diameter (mm)
Pebbles	2-75
fine pebbles	2-5
medium pebbles	5-20
coarse pebbles	20-75
Cobbles	75-250
Stones	250-600
Boulders	≥ 600

For fragments that are less than strongly cemented, "para" is added as a prefix to the above terms; i.e., paracobbles or fine parapebbles.

(4) **Entries**. Enter the minimum, maximum, and representative values in whole numbers of each size class being described. Entries are in millimeters and range from 2 to 3,000 mm.

(l) Fragment volume.

(1) **Definition**. Fragment volume is the volume percentage of the horizon occupied by the 2 mm or larger fraction.

(2) **Significance**. The volume occupied by the 2 mm or larger fraction is important for naming textural modifiers; i.e., gravelly, very gravelly, extremely paragravelly.

(3) **Entries**. Enter the high, low, and representative values, in whole numbers, for the percent volume present for each class of fragments being described.

618.29 Free Iron Oxides.

(a) Definition. Free iron oxides are secondary iron oxides, such as goethite, hematite, ferrihydrite, lepidocrocite, and maghemite. This form of iron may occur as discrete particles, as coatings on other soil particles, or as cementing agents between soil mineral grains. It is the iron extracted by dithionite-citrate from the fine earth fraction.

(b) Significance. The amount of iron that is extractable by dithionite-citrate is used in Soil Taxonomy in the Ferritic, Feruginous, Parasesquic, and Sesquic mineralogy classes. The ratio of dithionite-citrate (free) iron to total iron in a soil is a measure of the degree of soil weathering. Free iron oxides are important in the soil processes of podzolization and laterization and play a significant role in the phosphorous fixation ability of soils.

(c) Measurement. Free iron oxides are measured as the amount extracted by dithonite citrate using method 6C2b as outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) Entries. Enter high, low and representative values as percentages for each horizon for which data is available. Valid entries range from 0.00 to 99.99, and hundredths are allowed.

618.30 Frost Action, Potential.

(a) Definition. Potential frost action is the rating for the susceptibility of the soil to upward or lateral movement by the formation of segregated ice lenses. It rates the potential for frost heave and the subsequent loss of soil strength when the ground thaws.

(b) Classes. Classes are used in regions where frost action is a potential problem. Exhibit 618-5 provides more information. The classes are low, moderate, and high and are defined as follows:

Potential frost action classes	Definition
Low	Soils are rarely susceptible to the formation of ice lenses.
Moderate	Soils are susceptible to the formation of ice lenses, which results in frost heave and subsequent loss of soil strength.
High	Soils are highly susceptible to the formation of ice lenses, which results in frost heave and subsequent loss of soil strength.

(c) Significance. Damage from frost action results from the formation of segregated ice crystals and ice lenses in the soil and the subsequent loss of soil strength when the ground thaws. Frost heave damages highway and airfield pavements. It is less of a problem for dwellings and buildings that have footings which extend below the depth of frost penetration. In cold climates, unheated structures that have concrete or asphalt floors can be damaged by frost heave. Driveways, patios, and sidewalks can heave and crack. The thawing of the ice causes a collapse of surface elevation and produces free water perches on the still frozen soil below. Soil strength is reduced. Back slopes and side slopes of cuts and fills can slough during thawing. Seedlings and young plants of clover, alfalfa, wheat, and oats can be raised out of the soil or have their root systems damaged by frost heave.

(d) Estimates. Freezing temperatures, soil moisture, and susceptible soils are needed for the formation of segregated ice lenses. Ice crystals begin to form in the large pores first. Water in small pores or water that was adsorbed on soil particles freezes at lower temperatures. This super cooled water is strongly attracted to the ice crystals, moves toward it, and freezes on contact with them. The resulting ice lens continues to grow in width and thickness until all available water that can be transported by capillary has been added to the ice lens and a further supply cannot be made available because of the energy requirements.

Soil temperatures must drop below 0° C for frost action to occur. Generally, the more slowly and deeply the frost penetrates, the thicker the ice lenses are and the greater the resulting frost heave is. Exhibit 618-6 provides a map that shows the design freezing index values in the continental United States. The values are the number of degree days below 0° C for the coldest year in a period of 10 years. The values indicate duration and intensity of freezing temperatures. The 250 isoline is the approximate boundary below which frost action ceases to be a problem. Except on the West Coast, the frost action boundary corresponds closely to the mesic-thermic temperature regime boundary used in *Soil Taxonomy*. More information is provided in the U.S. Army Engineer School, Student Reference, 1967, Soil Engineering, Section I, Volume II, Chapters VI-IX, Fort Belvoir, Virginia.

Water necessary for the formation of ice lenses may come from a high water table or from infiltration at the surface. Capillary water in voids and adsorbed water on particles also contribute to ice lens formation; but unless this water is connected to a source of free water, the amount generally is insufficient to produce significant ice segregation and frost heave.

The potential intensity of ice segregation is dependent to a large degree on the effective soil pore size and soil saturated hydraulic conductivity, which are related to soil texture. Ice lenses form in soils in which the pores are fine enough to hold quantities of water under tension but coarse enough to transmit water to the freezing front. Soils that have a high content of silt and very fine sand have this capacity to the greatest degree and hence have the highest potential for ice segregation. Clayey soils hold large quantities of water but have such slow saturated hydraulic conductivity that segregated ice lenses are not formed unless the freezing front is slow moving. Sandy soils, however, have large pores and hold less water under lower tension. As a result, freezing is more rapid and the large pores permit ice masses to grow from pore to pore, entombing the soil particles. Thus, in coarse-grained soils, segregated ice lenses are not formed and less displacement can be expected.

Estimates of potential frost action generally are made for soils in mesic or colder temperature regimes. Exceptions are on the West Coast, where the mesic-thermic temperature line crosses below the 250 isoline, as displayed in Exhibit 618-6, and along the East Coast, where the soil climate is moderated by the ocean. Mesic soils that have a design freezing index of less that 250 degree days should not be rated because frost action is not likely to occur. The estimates are based on bare soil that is not covered by insulating vegetation or snow. They are also based on the moisture regime of the natural soil. The ratings can be related to manmade modifications of drainage or to irrigation systems on an on site basis. Frost action estimates are made for the whole soil to the depth of frost penetration, to bedrock, or to a depth of 2 meters (6.6 feet), whichever is shallowest. Exhibit 618-5 is a guide for making potential frost action estimates. It uses the moisture regimes and family textures as defined in Soil Taxonomy.

(e) Entries. Enter one of the following: LOW, MOD, or HIGH for the whole soil. If frost action is not a problem, enter NONE.

618.31 Gypsum.

(a) **Definition**. Gypsum is the percent, by weight, of hydrated calcium sulfates in the <20 mm fraction of soil.

(b) **Significance**. Gypsum is partially soluble in water and can be dissolved and removed by water. Soils with more than 10 percent gypsum, may collapse if the gypsum is removed by percolating water. Gypsum is corrosive to concrete. Corrosion of concrete is most likely to occur in soils that are more than about 1 percent gypsum when wetting and drying occurs.

(c) **Measurement**. Gypsum is measured by method 6F4, as outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) **Entries**. Enter the high, low, and representative values to represent the range in gypsum content as a weight percent of the soil fraction less than 20 mm in size. Round values to the nearest 5 percent for layers that are more than 5 percent gypsum and to the nearest 1 percent for layers that are less than 5 percent gypsum, for example, 0-1, 1-5, 5-10. If the horizon does not have gypsum, enter "0". Entries range from 0 to 120.

618.32 Horizon Depth to Bottom.

(a) **Definition**. Horizon depth to bottom is the distance from the top of the soil to the base of the soil horizon.

(b) **Measurement**. Distance is measured from the top of the soil, which is defined as the top of the mineral soil, or, for soil with "O" horizons, the top of any "O" layer that is at least partially decomposed. For soils that are covered by 80 percent or more rock or pararock fragments, the top of the soil is the surface of the fragments. See pages 63-64 in the Soil Survey Manual for a complete discussion. Measurement should be estimated to a depth of 200 cm for most soils and to a depth at least 25 cm below a lithic contact if the contact is above 175 cm. For soils, including those that have a root restricting contact such as a paralithic contact, the lowest horizon bottom should extend to a depth of at least 25 cm below the contact or to a depth of 200 cm, whichever is shallower.

(c) **Entries**. Enter the high, low, and representative values in whole centimeters. The high value represents either the greatest depth to which the base of the horizon extends or, for horizons extending beyond the limit of field observation, it is the depth to which observation was made (usually no more than 200 cm but at least 150 cm).

618.33 Horizon Depth to Top.

(a) **Definition**. Horizon depth to top is the distance from the top of the soil to the upper boundary of the soil horizon.

(b) **Measurement**. Distance is measured from the top of the soil, which is defined as the top of the mineral soil, or, for soils with "O" horizons, the top of any "O" layer that is at least partially decomposed. For soils that are covered by 80 percent or more rock or pararock fragments, the top of the soil is the surface of the fragments. See pages 63-64 in the Soil Survey Manual for a complete discussion.

(c) Entries. Enter the high, low, and representative values in whole centimeters. Refer to the discussion under "horizon designations" as to how to list E/B and E and Bt type horizons.

618.34 Horizon Designation.

(a) Definition. Horizon designation is a concatenation of three kinds of symbols used in various combinations to identify layers of soil that reflect the investigator's interpretations of genetic relationships among layers within a soil.

(b) Significance. Soils vary widely in the degree to which horizons are expressed. The range is from little or no expression to strong expression. Layers of different kinds are identified by symbols. Designations are provided for layers that have been changed by soil formation and for those that have not. Designations are assigned after comparison of the observed properties of the layer with properties inferred for the material before it was affected by soil formation. Designations of genetic horizons express a qualitative judgment about the kind of changes that are believed to have taken place. A more detailed discussion can be reviewed in the Soil Survey Manual, Chapter 3.

(c) Entries. Enter combinations of symbols. Each horizon identified in a soil description can be entered or, if there are no significant differences in other data elements between two horizons, they may be combined. Enter only what the documentation can support. For example, if the only horizons that the data identify are an A, B, and C, then only enter those horizons. If, on the other hand, an Ap, A1, A2, Bt1, Bt2, Btk, C1, and C2 are documented, then enter those horizons. If the Bt1 and Bt2 horizons in the above example have no significant differences in the data element values, then they can be combined into a Bt horizon. For E/Bt and E&Bt horizon types, it is necessary to enter the horizons designations twice since each part will have a different set of data elements values associated with that portion of the horizon. This procedure is addressed in Chapter 7 of the Pedon Description Program User's Guide. Allowable codes are listed in the NASIS data dictionary. Further discussion of rules for use can be found in the Soil Survey Manual, Chapter 3, and the Keys to Soil Taxonomy, Ninth Edition, 2003.

618.35 Horizon Thickness.

(a) Definition. Horizon thickness is a measurement from the top to bottom of a soil horizon throughout its areal extent.

(b) Measurement. Soil horizon thickness varies on a cyclical basis. Measurements should be made to record the range in thickness as it normally occurs in the soil.

(c) Entries. Enter the high, low, and representative values in whole centimeters. The minimum allowable entry is 1 cm. For horizons extending beyond the limit of field observation, thickness is calculated only to the depth to which observation was made.

618.36 Hydrologic Group.

(a) Definition. The complete definition and official criteria for hydrologic soil group is available online at http://directives.sc.egov.usda.gov/media/pdf/H_210_630_7.pdf (U.S. Department of

Agriculture, Natural Resources Conservation Service. 2007. National Engineering Handbook, Title 210-VI, Part 630, Chapter 7, Hydrologic Soil Groups. Washington, DC.) .

Hydrologic group is a group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonally high water table, and saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently.

(b) Classes. The soils in the United States are placed into four groups, A, B, C, and D, and three dual classes, A/D, B/D, and C/D.

(c) Significance. Hydrologic groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects, for planning or designing structures for the use, control, and disposal of water. They pertain to the minimum steady ponded infiltration under conditions of a bare wet surface.

(d) Measurements. The original classifications assigned to soils were based on the use of rainfall-runoff data from small watersheds and infiltrometer plots. From these data, relationships between soil properties and hydrologic groups were established.

(e) Estimates. Assignment of soils to hydrologic groups is based on the relationship between soil properties and hydrologic groups. Wetness characteristics, water transmission after prolonged wetting, and depth to very slowly permeable layers are properties that assist in estimating hydrologic groups.

(f) Entries. Enter the soil hydrologic group, such as A, B, C, D, A/D, B/D, or C/D.

618.37 Landform.

(a) Definition. Landform is any physical, recognizable form or feature of the earth's surface, having a characteristic shape and produced by natural causes.

(b) Significance. Geographic order suggests natural relationships. Running water, with weathering and gravitation, commonly sculptures landforms within a landscape. Over the ages, earthy material has been removed from some landforms and deposited on others. Landforms are interrelated. An entire area has unity through the interrelationships of its landform.

(1) Each landform may have one kind of soil present, or several. Climate, vegetation, and time of exposure to weathering of the parent materials are commonly about the same throughout the extent of the landform, depending on the relief of the area. Position on the landform may have influenced the soil-water relationships, microclimate, and vegetation.

(2) The proper identification of the landform is an important part of understanding the formative history of the soil and the materials from which they formed. This aids in the development of the soil mapping model, and in the transfer of information between areas.

(3) Landform terms are also used as phase criteria for separating mapping components or phases of a soil taxon.

(c) Classes. The allowable list of landform terms are included in the NASIS data dictionary. Definitions of the terms are included in part 629 of this handbook.

(d) Entries. Enter the appropriate class name for the landform(s) on which each map unit component occurs. A representative value (term) may be indicated. The capability is provided for indicating the presence of one landform occurring on another landform, i.e., a dune on a floodplain.

618.38 Linear Extensibility Percent.

(a) Definition. Linear extensibility percent is the linear expression of the volume difference of natural soil fabric at 1/3 bar or 1/10 bar water content and oven dryness. The volume change is reported as percent change for the whole soil.

(b) Classes. Shrink-swell classes are based on the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. If this change is expressed as a percent, the value used is LEP, linear extensibility percent. If it is expressed as a fraction, the value used is COLE, coefficient of linear extensibility. The shrink-swell classes are defined as follows:

Shrink-swell Class	LEP	COLE
Low	<3	<0.03
Moderate	3-6	0.03 - 0.06
High	6-9	0.06 - 0.09
Very High	≥9	≥0.09

(c) Significance. If the shrink-swell potential is rated moderate to very high, shrinking and swelling can damage buildings, roads, and other structures. The high degree of shrinkage associated with high and very high shrink-swell potentials can damage plant roots.

(d) Measurement. Coefficient of linear extensibility is measured directly as the change in clod dimension from moist to dry conditions and is expressed as a percentage of the volume change to the dry length:

$$\text{COLE} = \frac{\text{moist length - dry length}}{\text{dry length}}$$

When expressed as LEP (linear extensibility percent):

LEP = COLE X 100

Linear extensibility may be determined by any of the following methods:

(1) For the core method of measurement, select a sample core from a wet or moist soil. Carefully measure the wet length of the cores and set the core upright in a dry place. If the core shrinks in a symmetrical shape without excessive cracking or crumbling, its length can be measured and linear extensibility percent calculated. If the core crumbles or cracks, measurements cannot be accurately determined by this method.

(2) In the coated clod method of measurement, shrink-swell potential can be estimated from the bulk density of soil measured when moist and when dry. The coated clod method is widely used and is the most versatile procedure for determining bulk density of coherent soils. Procedures and calculations are given in Soil Survey Investigations Report No. 42, Soil Survey

Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS, which is obtainable from the National Soil Survey Center.

(3) Linear extensibility percent can be calculated from bulk density moist (Dbm) and bulk density dry (Dbd) using the following formula:

$$LEP = 100\,[(Dbd/Dbm)^{1/3} - 1]\,[1 - (\text{Volume } \% > 2\text{ mm}/100)]$$

This equation is used to simplify the determination of shrink-swell potential classes. The classes are as follows:

Dbd/Dbm	Shrink-Swell Potential
< 1.10	Low
1.10 - 1.20	Moderate
1.20 - 1.30	High
≥1.30	Very high

(e) **Estimates**. Field estimates of shrink-swell potential can be made by observing desiccation cracks, slickensides, gilgai, soil creep, and leaning utility poles. Shrink-swell potential correlates closely with the kind and amount of clay. The greatest shrink-swell potential occurs in soils that have high amounts of 2:1 lattice clays, such as smectites. Illitic clays are intermediate, and kaolinitic clays are least affected by volume change as the content in moisture changes.

(f) **Entries**. Enter the low, high, and representative linear extensibility percent values. The high and low values are to correspond to the high and low limits of the appropriate class. The range of valid entries is 0.00 to 30.00 percent.

618.39 Liquid Limit.

(a) **Definition**. Liquid limit is the water content of the soil (passing 40 sieve) at the change between the liquid and the plastic states.

(b) **Significance**. The plasticity chart, given in ASTM D 2487, is a plot of liquid limit (LL) versus plasticity index (PI) and is used in classifying soil in the Unified Soil Classification System. The liquid limit is also a criterion for classifying soil in the AASHTO Classification System, as shown in Exhibit 618-4. Generally, the amount of clay- and silt-size particles, the organic matter content, and the type of minerals determine the liquid limit. Soils that have a high liquid limit have the capacity to hold a lot of water while maintaining a plastic or semisolid state.

(c) **Measurement**. Tests are made on thoroughly puddled soil material that has passed a No. 40 (425 mm) sieve, and is expressed on a dry weight basis, according to ASTM method D 4318. This procedure requires the use of a liquid limit device, a special tool designed to standardize the arbitrary boundary between a liquid and plastic state of a soil. Estimates of liquid limit are made on soils during soil survey investigations and mapping activities. The liquid limit is usually inferred from clay mineralogy and clay content. If soils are tested later in the laboratory, adjustments are made to the field estimates as needed. Generally, experienced personnel can estimate these values with a reasonable degree of accuracy.

(d) Estimates. The formula in Exhibit 618-7 is used within the National Soil Information System to provide default calculated values if no measurements are available.

(e) Entries. Enter the high, low, and representative values as a range of percentages. Entries are allowed to tenths of a percent; however, entries should be rounded to the nearest 10 except where they are measured. Enter "0" for nonplastic soils. The liquid limit for organic soil material is not defined, and is assigned "null."

618.40 Organic Matter.

(a) Definition. Organic matter percent is the weight of decomposed plant and animal residue and expressed as a weight percentage of the soil material less than 2 mm in diameter.

(b) Significance. Organic matter influences the physical and chemical properties of soils far more than the proportion to the small quantities present would suggest. The organic fraction influences plant growth through its influence on soil properties. It encourages granulation and good tilth, increases porosity and lowers bulk density, promotes water infiltration, reduces plasticity and cohesion, and increases the available water capacity. It has a high cation-adsorption capacity and is important to pesticide binding. It furnishes energy to micro-organisms in the soil. As it decomposes, it releases nitrogen, phosphorous, and sulfur. The distribution of organic carbon with depth indicates different episodes of soil deposition or soil formation.

(1) Soils that are very high in organic matter have poor engineering properties and subside upon drying.

(c) Measurement. Measurements are made using total combustion to determine total carbon. Carbonate carbon is then determined and subtracted to provide an estimate of organic carbon. The results are given as the percent of organic carbon in dry soil. To convert the figures for organic carbon to those for organic matter, multiply the organic carbon percentage by 1.724. The detailed procedures will be outlined in the next version of Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, USDA, NRCS.

(d) Estimates. Color and "feel" are the major properties used to estimate the amount of organic matter. Color comparisons in areas of similar materials can be made against laboratory data so that a soil scientist can make estimates. In general, black or dark colors indicate high amounts of organic matter. The contrast of color between the A horizon and subsurface horizons is also a good indicator.

(e) Entries. Enter the high, low, and representative values to represent the range for each horizon. Use whole numbers for entries that are 1 and above; use tenths for those that are less than 1.

618.41 Parent Material, Kind, Modifier, and Origin.

Parent material is the unconsolidated material, mineral or organic, from which the soil develops. The soil surveyor uses parent material to develop a model used for soil mapping. Soil scientists and specialists in other disciplines use parent material to help interpret soil boundaries and project performance of the material below the soil. Many soil properties relate to parent material. Among these properties are proportions of sand, silt, and clay; chemical content; bulk density; structure; and the kinds and amounts of fragments. These properties affect interpretations and may be criteria to separate soil series. Soil properties and landscape information infer parent material. Three data elements -- parent material kind, parent material modifier, and parent material origin describe parent material.

(a) Parent Material Kind.

(1) **Definition**. Parent material kind is a term describing the general physical, chemical and mineralogical composition of the material, mineral or organic, from which the soil develops. Mode of deposition and/or weathering may be implied or implicit.

(2) **Classes**. The list of allowable entries are included in the NASIS data dictionary. Definitions of many of these terms are included in Part 629 of this handbook.

(3) **Entries**. Enter the applicable class name(s) for each map unit component. Multiple entries are permissible. Multiple layers of parent materials may also be indicated for a single component, such as loess over till over residuum.

(b) Parent Material Modifier.

(1) **Definition**. Parent material modifier is the general description of the texture of the parent material. Class limits correspond to those of textural groupings defined in Soil Survey Manual and family particle-size classes of Soil Taxonomy.

(2) **Classes**. The classes of parent material modifiers are:

Clayey	Loamy
Coarse-loamy	Sandy
Coarse-silty	Sandy and gravelly
Fine-loamy	Sandy and silty
Fine-silty	Silty
Gravelly	Silty and clayey

(3) **Entries**. Enter the appropriate class name to modify the corresponding layer of parent material kind as desired.

(c) Parent Material Origin.

(1) **Definition**. Parent material origin is the type of bedrock from which the parent material was derived.

(2) **Classes**. The allowable class names are included in the NASIS data dictionary and are the same as for the "bedrock kind" data element.

(3) **Entries**. Enter the appropriate "parent material origin" class name(s) to correspond with each "parent material kind" as desired. This data element is intended to be used when "residuum" is the chosen parent material kind. However, it may also be used with other kinds of parent material.

618.42 Particle Density.

(a) Definition. Particle density is the mass per unit of volume of the solid soil particle, either mineral or organic. Also known as specific gravity.

(b) Significance. Particle density is used in the calculation of weight and volume for soil (porosity). The relationship of bulk density, percent pore space, and the rate of sedimentation of solid particles in a liquid depends on particle density. The term particle density indicates wet particle density or specific gravity.

(c) Measurement. The standard methods of measurement for particle density are the ASTM Standard Test Method for Specific Gravity of Soils, ASTM designation D 854-92, which uses soil materials passing a No. 4 sieve; the method described by Blake and Hartge in Methods of Soil Analysis, Part

1, Agronomy 9; or the method for volcanic soils described by Bielders and others in Soil Sci. Soc. Am. J. 54: 822-826.

(d) Estimates. Particle density is often assumed to be 2.65 g cm^{-3}; however, many minerals and material of various origins exhibit particle densities less than or greater than this "standard." Particle density (Dp) may be calculated using the extractable iron and the organic carbon percentages in the following formula:

$$Dp = \frac{100}{\frac{(1.7 \times OC)}{Dp1} + \frac{(1.6 \times Fe)}{Dp2} + \frac{100 - [(1.7 \times OC) + (1.6 \times Fe)]}{Dp3}}$$

OC is the organic carbon percentage and Fe is the extractable iron determined by method 6C2 (Soil Survey Laboratory Staff, 1992) or by an equivalent method. The particle density of the organic matter (Dp1) is assumed to be 1.4 g cm^{-3}; that of the minerals from which the extractable iron originates (Dp2) is assumed to be 4.2 g cm^{-3}, and that of the material exclusive of the organic matter and the minerals contributing to the extractable Fe (Dp3) is assumed to be 2.65 g cm^{-3}.

(e) Entries. Enter the representative value. The range of valid entries is 1.0 to 6.0 g cm^{-3}. Hundredths are allowable.

618.43 Particle Size.

(a) Definition. Particle size is the effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific, effective diameter class limits. The broad classes are clay, silt, and sand, ranging from the smaller to the larger of the less than 2 mm mineral soil fraction. It includes fragments of weathered or poorly consolidated fragments that disperse to particles less than 2 mm.

(b) Significance. The physical behavior of a soil is influenced by the size and percentage composition of the size classes. Particle size is important for most soil interpretations, for determination of soil hydrologic qualities, and for soil classification.

(c) Measurement. Particle size is measured by sieving and sedimentation. The method used is Method 3A1, which is outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) Classes. The United States Department of Agriculture uses the following size separates for the <2 mm mineral material:

USDA Particle size separates	Size (mm)
Clay, total	<0.002
Silt, total	0.002 - 0.05
Silt, fine	0.002 - 0.02
Silt, coarse	0.02 - 0.05
Sand total	0.05 - 2.00
Very fine sand	0.05 - 0.10
Fine sand	0.10 - 0.25
Medium sand	0.25 - 0.50
Coarse sand	0.50 - 1.00
Very coarse sand	1.00 - 2.00

Exhibit 618-8 compares the USDA system with the AASHTO and Unified Soil Classification System and shows the U.S. standard sieve sizes.

(e) Clay percentage.

(1) Definition. Total clay percentage is the weight percentage of the mineral particles less than 0.002 mm in equivalent diameter in the less than 2 mm soil fraction. Most of the material is in one of three groups of clay minerals or a mixture of these clay minerals. The groups are kaolinite, smectite, and hydrous mica, the best known member of which is illite.

(2) Significance. Physical and chemical activities of a soil are related to the kind and amount of clay minerals. Clay particles may have thousands of times more surface area per gram than silt particles and nearly a million times more surface area than very coarse sand particles. Thus, clay particles are the most chemically and physically active part of mineral soil.

(i)Clay mineralogy and clay percentage have a strong influence on engineering properties and the behavior of soil material when it is used as construction or foundation material. They influence linear extensibility, compressibility, bearing strength, and saturated hydraulic conductivity.

(ii) The kind and amount of clay influence plant growth indirectly by affecting available water capacity, water intake rate, aeration, cation exchange capacity, saturated hydraulic conductivity, erodibility, and workability. Up to a certain point, an increase in the amount of clay in the subsoil is desirable. Clay can increase the amount of water and nutrients stored in that zone. By slightly slowing the rate of water movement, it can reduce the rate of nutrient loss through leaching. If the amount of clay is great, it can impede water and air movement, restrict root penetration, increase runoff and, on sloping land, result in increased erosion.

(iii) Clay particles are removed by percolating water from surface and subsurface horizons and deposited in the subsoil horizons. The amount of clay accumulation and its location in the profile provide clues for the soil scientist about soil genesis. Irregular clay distribution as related to depth may indicate lithologic discontinuities, especially if accompanied by irregular sand distribution.

(3) Measurement. Clay content is measured in the laboratory by the pipette or hydrometer methods after the air-dry soil is pretreated to remove organic matter and soluble salts. Field estimates of clay content are made by manual methods. The way a wet soil ribbons, or develops a long continuous ribbon, when pressed between the thumb and fingers gives a good idea of the amount of clay present. Excessive amounts of sodium can toughen the soil, making the soil feel more clayey. Care should be taken not to overestimate the amount of clay in sodic soils. Accuracy depends largely on frequent and attentive observation. Texture reference samples determined in the laboratory are used by soil scientists to calibrate the feel of soils with various percentages of clay.

(4) **Entries.** Enter the high, low, and representative values of the clay total separate as a percent of the material less than 2 mm in size for each horizon. Enter a "0" if amount is not significant, as in organic layers or in some andic soil materials. The representative value should equate to the representative (clay total separate) "texture class" posted for each horizon.

(f) **Sand Percentage.**

(1) **Definition**. Sand percentage is the weight percentage of the mineral particles less than 2 mm and greater than or equal to 0.05 mm in equivalent diameter in the less than 2 mm soil fraction. The sand separates recognized are very coarse, coarse, medium, fine, very fine, and total. Respective size limits are shown in paragraph 618.44(d) above. Much of the sand fraction is composed of fragments of rocks and primary minerals, especially quartz. Therefore, the sand fraction is quite chemically inactive.

(2) **Significance**. Physical properties of the soil are influenced by the amounts of total sand and of the various sand fractions present in the soil. Sand particles, because of their size, have a direct impact on the porosity of the soil. This influences other properties, such as saturated hydraulic conductivity, available water capacity, water intake rates, aeration, and compressibility related to plant growth and engineering uses.

(3) **Measurement**. Sand content is measured in the laboratory by the wet sieving method and then fractionated by dry sieving. Field estimates are made by manual methods. The degree of grittiness in a wet soil sample, when worked between the thumb and forefinger, gives an estimate of the sand content. The size of sand grains may be observed with the naked eye or with the aid of a hand lens.

(4) **Entries**. Enter the high, low, and representative value of each sand size separate (sand coarse separate, sand fine separate, sand medium separate, sand very coarse separate, sand very fine separate, sand total separate) as a percent of the material less than 2 mm in size for each horizon. Enter a "0" if amount is not significant, as in organic layers or in some andic soil materials. The representative value should equate to the representative "texture class" posted for each horizon.

(g) **Silt Percentage.**

(1) **Definition**. Silt percentage is the weight percentage of the mineral particles greater than or equal to 0.002 mm but less than 0.05 mm in the less than 2 mm soil fraction. The silt separates recognized are fine, coarse, and total. The respective size limits are listed in paragraph 618.44 (d) above. The silt separate is dominated by primary minerals, especially quartz, and therefore has a low chemical activity.

(2) **Significance**. The silt separate possesses some plasticity, cohesiveness, and absorption, but to a much lesser degree than the clay separate. Silt particles act to slow water and air movement through the soil by filling voids between sand grains. A very high content of silt in a soil may be physically undesirable for some uses unless supplemented by adequate amounts of sand, clay, and organic matter.

(3) **Measurement**. The silt content is measured in the laboratory in two phases. The fine silt is measured using the pipette method on the suspension remaining from the wet sieving process. Aliquots of the diluted suspension are removed at predetermined intervals based on Stokes Law. The aliquots are then dried and weighed. The coarse silt fraction is the difference between 100 percent and the sum of the sand, clay, and fine silt percentages.

The silt content may be estimated in the field using the ribbon test as described for clay. The content of silt is usually estimated by first estimating the clay and sand portions and then subtracting that number from 100 percent. Silt tends to give the soil a smooth feel.

(4) **Entries**. Enter the high, low, and representative value of each silt size separate (silt coarse separate, silt fine separate, silt total separate) as a percent of the material less than 2 mm in size for each horizon. Enter a "0" if amount is not significant, as in organic layers or in some andic soil materials. The representative value should equate to the representative "texture class" posted for each horizon.

618.44 Percent Passing Sieves.

(a) **Definition**. The percent passing sieve numbers 4, 10, 40, and 200 is the weight of material that passes these sieves, based on the material less than 3 inches (75 mm) in size, expressed as a percentage.

(b) **Significance**. Data for the percent passing sieves are used to classify the soil in the engineering classifications and to make judgments on soil properties and performance. Many soil characteristics are influenced by the depth distribution of grain size for the soil as well as its mode of deposition, stress history, density, and other features.

(c) **Measurement**. Measurements involve sieve analysis for the determination of grain size distribution of that portion of the soil having particle diameters between 3 inches and 0.074 mm (No. 200 sieve). ASTM methods D 422, C 136, and C 117 have applicable procedures that are used where appropriate. Measurements are made on most benchmark soils and other representative soils in survey areas.

(d) **Estimates**. Estimates of the content of sand, silt, clay, and rock fragments that are made for soils during soil survey investigations and mapping activities are used to estimate percent passing sieves. If samples are tested later in a laboratory, adjustments are made to the field estimates as needed. Generally, experienced personnel can estimate these values with a high degree of accuracy. Estimates for percent passing sieves can be made from soil texture using the following general guidance:

Percent passing #200 = clay + silt + 1/2 very fine sand

Percent passing #40 = 1/2 very fine sand + fine sand + 1/2 medium sand + percent passing #200

The percent passing #10 equals the less than 2 mm fraction, and soil texture is based on the less than 2 mm fraction. Since sieves represent the less than 3-inch fraction, the #40 and #200 sieve estimates must be adjusted when the percent passing #10 is less than 100 percent. The percent passing #40 and #200 that is determined above by texture must be adjusted by multiplying the percent passing #40 and percent passing #200 by the percent passing #10. Pararock fragments are not cemented strongly enough to be retained on sieves. They are crushed and estimated into percent passing sieves.. ASTM procedures use a roller crusher as a pretreatment of the soil material prior to sieving . Field estimates should try to replicate this procedure.

(e) **Entries**. Enter the high, low, and representative values to represent the range of percent passing each sieve size for each horizon. The range includes the estimating accuracy as well as the range of values for a soil. Entries are allowable as tenths of a percent and range from 0 to 100 percent.

618.45 Plasticity Index.

(a) **Definition**. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It is the range of water content in which a soil exhibits the characteristics of a plastic solid. The plastic limit is the water content that corresponds to an arbitrary limit between the plastic and semisolid states of a soil.

(b) **Significance**. The plasticity index, when used in connection with the liquid limit, serves as a measure of the plasticity characteristics of a soil. The plasticity chart, given in ASTM D 2487, is a plot of the liquid limit (LL) versus the plasticity index (PI) and is used in classifying soil in the Unified Soil Classification System. The plasticity index is also a criterion for classifying soil in the AASHTO Classification System, as shown in Exhibit 618-4. Soils that have a high plasticity index have a wide range of moisture content in which the soil performs as a plastic material. Highly and moderately plastic clays have large PI values.

(c) **Measurements**. Tests are made on that portion of the soil having particles passing the No. 40, (425 micrometer) sieve, according to ASTM Method D 423. Measurements are made on most benchmark soils and on other representative soils in survey areas. Estimates of plasticity index are made on all soils during soil survey investigations and mapping activities. The plasticity index is usually not estimated directly, but a position on the plasticity chart in ASTM D 2487 is estimated. The plasticity index can then be determined from the chart. If soils are later tested in the laboratory, adjustments are made to the field procedures as needed. Generally, experienced personnel can estimate these values with a reasonable degree of accuracy. Estimates are expressed in ranges that include the estimating accuracy as well as the range of values from one location to another within the map unit.

(d) **Estimates**. The formula in Exhibit 618-7 is used within the National Soil Information System to provide default calculated values if no measurements are available.

(e) **Entries**. Enter the high, low, and representative values to represent the range for each horizon. Round to the nearest 5 percent unless the values are measured. Entries may range from 0 to 130. Enter "0" for nonplastic soils. The plasticity index for organic soil material is not defined, and is assigned "null."

618.46 Ponding Depth, Duration, Frequency Class, and Month.

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding of soils is classified according to depth, frequency, duration, and the beginning and ending months in which standing water is observed.

(a) Ponding depth.

(1) **Definition**. Ponding depth is the depth of surface water that is ponding on the soil.

(2) **Entries**. Enter the high, low, and representative values for the ponding depth, in centimeters, for the map unit component. Entries are whole numbers that range from 0 to 185 centimeters.

(b) Ponding duration class.

(1) **Definition**. Ponding duration class is the average duration, or length of time, of the ponding occurrence.

(2) **Classes**. The ponding duration classes are:

Ponding Duration Class	Duration of the ponding occurrence
VERY BRIEF	Less than 2 days
BRIEF	2 to 7 days
LONG	7 to 30 days
VERY LONG	≥30 days

(3) **Entries**. Enter VERY BRIEF, BRIEF, LONG, or VERY LONG for the map unit component. Only use entries if ponding occurs more often than rare.

(c) Ponding frequency class.

(1) **Definition**. Ponding frequency class is the number of times ponding occurs over a period of time.

(2) **Classes**. The ponding frequency classes are:

Ponding Frequency Class	Definition
NONE	No reasonable possibility of ponding, near 0 percent chance of ponding in any year
RARE	Ponding unlikely but possible under unusual weather conditions; from nearly 0 to 5 percent chance of ponding in any year or nearly 0 to 5 times in 100 years
OCCASIONAL	Ponding is expected infrequently under usual weather conditions; 5 to 50 percent chance of ponding in any year or nearly 5 to 50 times in 100 years
FREQUENT	Ponding is likely to occur under usual weather conditions; more than 50 percent chance in any year or more than 50 times in 100 years

(3) **Entries**. Enter NONE, RARE, OCCASIONAL, or FREQUENT as appropriate for the map unit component.

(d) Ponding month.

(1) **Definition**. Ponding month is the calendar month(s) in which ponding is expected.

(2) **Classes**. The time of year when ponding is likely to occur is expressed in months for the expected beginning to expected end of the ponding period. The time period expressed includes two-thirds to three-fourths of the occurrences.

(3) **Entries**. Enter the name of each month of the year in which ponding is expected.

(e) Significance. The susceptibility of soils to ponding is important for homes, building sites, and sanitary facilities. Time and duration of the ponding are critical factors determining plant species. Ponding during the dormant season has few if any harmful effects on plant growth or mortality and, may even improve growth.

(f) Estimates. Generally, estimates of ponding frequency and duration can be made for each soil. Where the natural infiltration, saturated hydraulic conductivity, and surface and subsurface drainage of soils is altered, ponding studies are needed to reflect present ponding characteristics.

(1) Evidence of ponding events should be gathered during soil survey field work. High water lines and other signs of maximum water height are recorded. Other records may also exist.

(2) Certain landform features are subject to ponding. These features are characteristics of closed drainage systems and include potholes, playas, sloughs, and backswamps. Most of these features are recognizable when correlating features on aerial photographs with ground observations. Different kinds of vegetation and soils are normally associated with these geomorphic features.

(3) The vegetation that grows in ponded areas may furnish clues to past ponding and indicate the potential for ponding in the future. Generally, native vegetation in ponded areas consists of obligate and facultative wet hydrophytes. Some plant species are intolerant of ponding and do not grow in areas that are ponded.

(4) The soil provides clues to past ponding, but characteristics vary according to climate and soil conditions. Some of the clues are (i) a dark surface horizon or layer overlying a gleyed subsoil; (ii) many prominent redoximorphic features that have low value and chroma; (iii) capillary transport and concentrations of carbonates or sulfates, or both, in the upper soil horizons; and (iv) dark colors and high levels of organic matter throughout the profile or any combination of these features.

618.47 Pores.

Pore space is a general term for voids in the soil material. The term includes matrix, nonmatrix, and interstructural pore space. For water movement at low suction and conditions of satiation, the nonmatrix and interstructural porosity have particular importance.

- **Matrix pores**. Matrix pores are formed by the agents that control the packing of the primary soil particles. These pores are usually smaller than nonmatrix pores. Additionally, their aggregate volume and size would change markedly with water state for soil horizons or layers with high extensibility.
- **Nonmatrix pores**. Nonmatrix pores are relatively large voids that are expected to be present when the soil is moderately moist or wetter, as well as under drier states. The voids are not bounded by the planes that delimit structural units. Nonmatrix pores may be formed by roots, animal, action of compressed air, and other agents. The size of the distribution of nonmatrix pores usually bears no relationship to the particle size distribution and the related matrix pore size distribution.
- **Interstructural pores**. Interstructural pores are delimited by structural units. Inferences as to the interstructural porosity may be obtained from the structure description. Commonly, interstructural pores are at least crudely planar.

Nonmatrix pores are described by quantity, size, shape, and vertical continuity--generally in that order.

(a) Pore quantity.

(1) Definition. Pore quantity is the classes that pertain to the number of a selected size of pores per unit area of undisturbed soils--1 cm2 for very fine and fine pores, 1 dm2 for medium and coarse pores, and 1 m2 for very coarse pores.

(2) Classes. The pore quantity classes are:

Pore Quantity Class	Number of pores per unit area
Few	<1
Common	≥1-5
Many	≥5

(3) Entries. Enter pore quantity as pores/area. Enter the high, low, and representative values as a whole number between 0 and 99 for the horizon.

(b) Pore size.

(1) Definition. Pore size is the average diameter of the pore.

(2) Classes. The pore size classes are:

Pore Size Class	Pore Size (mm)
Very fine	<1
Fine	1-2
Medium	2-5
Coarse	5-10
Very Coarse	≥ 10

(3) Entries. Enter a single class or a combination of size classes for the horizon. Acceptable entries for pore size class are very fine, very fine and fine, very fine to medium, very fine to coarse, fine, fine and medium, fine to coarse, medium, medium and coarse, coarse, and very coarse.

(c) Pore shape.

(1) Definition. Pore shape is a description of the multiarial shape of the pore. Most nonmatrix pores are either vesicular (approximately spherical or elliptical) or tubular (approximately cylindrical and elongated). Some are irregularly shaped and referred to as interstitial. Additionally, the following designations are utilized:

(i) Continuous--if nonmatrix pore extends vertically through the thickness of the horizon or layer.

(ii) Discontinuous--the nonmatrix pore does not extend vertically through the thickness of the horizon or layer.

(iii) Constricted--the tubular pores are plugged with clay.

(iv) Dendritic--the tubular pores branch out of a main stem.

(2) Classes. The pore shape classes are:

Constricted tubular	Interstitial and tubular
Continuous tubular	Tubular
Dendritic tubular	Vesicular
Discontinuous tubular	Vesicular and tubular
Filled with coarse material	Void between fragments
Interstitial	

(3) Entries. Enter one of the choices from the class list for the horizon.

(d) Vertical continuity.

(1) Definition. Vertical continuity is the average vertical distance through which the minimum pore diameter exceeds 0.5 mm when the soil layer is moist or wetter.

(2) Classes. The vertical continuity classes are:

Vertical Continuity Class	Vertical distance (cm)
Low	< 1
Moderate	1-10
High	≥ 10

(3) Entries. Enter one of the vertical continuity classes.

618.48 Reaction, Soil (pH).

(a) Definition. Soil reaction is a numerical expression of the relative acidity or alkalinity of a soil.

(b) Classes. The descriptive terms for reaction and their respective ranges in pH are:

Reaction Class	Range in pH
Ultra acid	1.8-3.4
Extremely acid	3.5-4.4
Very strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Moderately acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Slightly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	9.1-11.0

(c) Significance. A principal value of soil pH is the information it provides about associated soil characteristics. Two examples are phosphorus availability and base saturation. Soils that have a pH of approximately 6 or 7 generally have the most ready availability of plant nutrients. Strongly acid or more acid soils have low extractable calcium and magnesium, a high solubility of aluminum, iron, and boron, and a low solubility of molybdenum. In addition, these soils have a possibility of organic toxins and generally have a low availability of nitrogen and phosphorus. At the other extreme are alkaline soils. Calcium, magnesium, and molybdenum are abundant with little or no toxic aluminum, and nitrogen will be readily available. If pH is above 7.9, the soils may have an inadequate availability of iron, manganese, copper, zinc, and especially of phosphorus and boron.

Soil reaction is one of several properties used as a general indicator of soil corrosivity or its susceptibility to dispersion. In general, soils that are either highly alkaline or highly acid are likely to be corrosive to steel. Soils that have pH <5.5 are likely to be corrosive to concrete. Soils that have pH >8.5 are likely to be highly dispersible, and piping may be a problem.

(d) Measurement. The most common soil laboratory measurement of pH is the 1:1 water method. A crushed and sieved soil sample is mixed with an equal amount of water, and a measurement is made of the suspension using a pH meter. Another method used, especially for Histosols, is the 0.01M calcium chloride method. In NASIS these two methods are shown as separate data elements.

(1) The pH values derived from water suspension are affected by field applications of fertilizer or other salts in the soil, the content of carbon dioxide in the soil, and even moisture content at the time of sampling. The 0.01M calcium chloride method reduces these influences.

(2) The laboratory methods are described in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(e) Estimates. A variety of field test kits are available for determination of pH in the field. The methods include a water-soluble dye, which is mixed with soil and thus produces a color that is compared with a chart; a dye-impregnated paper, which changes color according to differences in pH; and portable glass electrodes. Each state office can recommend a suitable pH method for the soils in the state. If requested, the Soil Survey Laboratory makes suggestions for suitable methods for field measurements and furnishes NRCS soil scientists with the proper chemicals.

(f) Entries. Soil reaction (pH) is time and moisture dependent, and water pH can vary up to a whole unit during the growing season. The range of pH should reflect the variations. The 1:1 water method generally is used except for Histosols, which are measured in 0.01M calcium chloride. Separate entries are made for "pH 1 to 1 water" and "pH 0.1M calcium chloride", depending on whether the horizon is mineral or organic. Enter the high, low, and representative values of the appropriate estimated pH range for each horizon. The high and low values are to correspond with the class limits as follows:
1.8-3.4, 3.5-4.4, 4.5-5.0, 5.1-5.5, 5.6-6.0, 6.1-6.5, 6.6-7.3, 7.4-7.8, 7.9-8.4, 8.5-9.0, 9.1-11.0; or enter a combination of classes, for example, 4.5-5.5.

618.49 Restriction Kind, Depth, Thickness, and Hardness.

Identify and describe restrictive soil layers in the field. Observe, measure, and record restriction kind, hardness, depth, and thickness.

When describing pedons, if possible, identify types or kinds of restrictions by suffix symbols, such as "d," "f," "m," "r," "v," or "x;" or by the master layer "R."

(a) Restriction kind.

(1) **Definition**. Restriction kind is the type of nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly reduce the movement of water and air through the soil or that otherwise provide an unfavorable root environment. Cemented layers, dense layers, frozen layers, abrupt or stratified layers, strongly contrasting textures, and dispersed layers are examples of soil layers that are restrictions.

(2) Classes. The choices for restriction kind are:

Abrupt textural change	Petrocalcic
Bedrock (lithic)	Petroferric
Bedrock (paralithic)	Petrogypsic
Cemented horizon	Placic
Dense material	Plinthite
Duripan	Salic
Fragipan	Strongly contrasting textural stratification
Natric	Sulfuric
Ortstein	Undefined
Permafrost	

(3) Entries. Enter the appropriate choice for the horizon or layer.

(b) Restriction depth.

(1) Definition. Restriction depth is the vertical distance from the soil surface to the upper and to the lower boundary of the restriction.

(2) Entries. Enter the high, low, and representative values for upper and lower restriction depths in centimeters using whole numbers.

(c) Restriction thickness.

(1) Definition. Restriction thickness is the distance from the top to the bottom of a restrictive layer.

(2) Entries. Enter the high, low, and representative values for the thickness in whole centimeters using whole numbers from 1 to 999.

(d) Restriction hardness.

(1) Definition. Restriction hardness is the rupture resistance of an air-dried, then submerged block-like specimen of mineral material. Ice is not applicable.

(2) Classes. Restriction hardness is rated using the following classes and operation descriptions:

Restriction hardness class	Operation description
Not applicable	Specimen not obtainable
Noncemented	Fails under very slight force applied slowly between thumb and forefinger (<8N).
Extremely weakly cemented	Fails under slight force applied slowly between thumb and forefinger (8 to 20N).
Very weakly cemented	Fails under moderate force applied slowly between thumb and forefinger (20 to 40N).
Weakly cemented	Fails under strong force applied slowly between thumb and forefinger (about 80N maximum force can be applied) (40 to 80N).
Moderately cemented	Cannot be failed between thumb and forefinger but can be failed between both hands or by placing specimen on a nonresilient surface and applying gentle force underfoot (80 to 160N).
Strongly cemented	Cannot be failed in hands but can be failed underfoot by full body weight (about 800N) applied slowly (160 to 800N).
Very strongly cemented	Cannot be failed underfoot by full body weight but can be failed by <3J blow (800N to 3J).
Indurated	Cannot be failed by blow of 3J (> 3J).

Both force (Newtons, N) and energy (joules, J) are employed. The number of Newtons is 10 times the kilograms of force. One joule is the energy delivered by dropping a 1 kg weight a distance of 10 cm.

(3) Measurement. For measurements of the restriction hardness, use the procedures and classes of cementation that are listed with the rupture resistance classes. Classes are described for like specimens about 25-30 mm on edge which are air-dried and then submerged in water for at least 1 hour. Compress the specimen between extended thumb and forefinger, between both hands, or between the foot and a nonresilient flat surface. If the specimen resists compression, drop a weight onto it from progressively greater heights until it ruptures. Failure is the point of the initial detection of deformation or rupture. Stress applied in the hand should be over a 1-second period. Learn the tactile sense of the class limits by applying force to top loading scales and sensing the pressure through the tips of the fingers or through the ball of the foot. Use postal scales for the resistance range that is testable with the fingers. Use a bathroom scale for the higher rupture resistance range.

(4) Entries. Enter the appropriate class name without the word "cemented"; i.e., use "moderately" for moderately cemented.

(e) Significance. Restriction layers limit plant growth by restricting the limits of the rooting zone. They also impede or restrict the movement of soil water vertically through the soil profile and have a direct impact on the quality and quantity of ground water and surface water. Restriction hardness and thickness have a significant impact on the ease of mechanical excavation. Use excavation difficulty classes to evaluate the relationships of restriction layers to excavations.

(f) Measurements. Use measurements or observations made throughout the extent of occurrence of a soil as a base for estimates of restriction kind, depth, thickness, and hardness.

618.50 Saturated Hydraulic Conductivity

(a) **Definition**. Saturated hydraulic conductivity is the amount of water that would move vertically through a unit area of saturated soil in unit time under unit hydraulic gradient

(b) **Significance**. Saturated hydraulic conductivity is used in soil interpretations. It is also known as Ksat.

(c) **Measurement**. Means, such as the Amoozemeter and double ring infiltrometers, provide some basis for estimation of saturated hydraulic conductivity. but no method has been accepted as a standard. Since measurements are difficult to make and are available for relatively few soils, estimates of saturated hydraulic conductivity are based on soil properties.

(d) **Estimates**. The soil properties that affect saturated hydraulic conductivity are distribution, continuity, size, and shape of pores. Since the pore geometry of a soil is not readily observable or measurable, observable properties related to pore geometry are used to make estimates of saturated hydraulic conductivity. These properties are texture, structure, pore size, density, organic matter, and mineralogy. Exhibit 618-9 provides a guide for estimating saturated hydraulic conductivity from soil texture and bulk density with a guide for use with overriding conditions.

(1) In making estimates, the soil characteristic that exerts the greatest control for many soils is texture.

(2) The general relationships in Exhibit 618-9 are adjusted up or down depending on bulk density. Structure, pore size, organic matter, clay mineralogy, and other observations within the soil profile, such as consistency, dry layers in wet seasons, root mats or absence of roots, and evidence of perched water levels or standing water are good field indicators for adjusting estimates.

(3) Water movement through lithic and paralithic materials can be estimated from the guide in Exhibit 618-10.

(e) **Entries**. Enter the high, low, and representative values of saturated hydraulic conductivity for each horizon. The range of valid entries for saturated hydraulic conductivity is 0.00 to 705.00 µm s-1. Four decimal places are allowed.

618.51 Slope Aspect.

(a) **Definition**. Slope aspect is the direction toward which the surface of the soil faces.

(b) **Significance**. Slope aspect may affect soil temperature, evapotranspiration, winds received, and snow accumulation.

(c) **Measurement**. Slope aspect is measured clockwise from true north as an angle between 0 and 360 degrees..

(d) **Entries**. Enter the slope aspect counter-clockwise, slope aspect clockwise, and slope aspect representative for each map unit component. The minimum is 0 degrees and the maximum is 360 degrees.

(1) **Slope aspect counter-clockwise** is one end of the range in characteristics for the slope aspect of a component. This end of the range is expressed in degrees measured clockwise from true north, but in the direction counter-clockwise from the representative slope aspect.

(2) **Slope aspect clockwise** is one end of the range in characteristics for the slope aspect of a component. This end of the range is expressed in degrees measure clockwise from true north, and in the direction clockwise from the representative slope aspect.

(3) **Slope aspect representative** is the common, typical, or expected direction toward which the surface of the soil faces, measured in degrees clockwise from true north.

618.52 Slope Gradient.

(a) **Definition**. Slope gradient is the difference in elevation between two points and is expressed as a percentage of the distance between those points. For example, a difference in elevation of 1 meter over a horizontal distance of 100 meters is a slope of 1 percent.

(b) **Significance**. Slope gradient influences the retention and movement of water, the potential for soil slippage and accelerated erosion, the ease with which machinery can be used, soil-water states, and the engineering uses of the soil.

(c) **Measurement**. Slope gradient is usually measured with a hand level or clinometer. The range is determined by summarizing data from several sightings.

(d) **Entries**. Enter the high, low, and representative values to represent the range of slope gradient as a percentage for the map unit component. Entries for high and low are whole number integers and range from 0 to 999. Entries for representative values below 1 percent can be given in tenths of a percent.

618.53 Slope Length.

(a) **Definition**. Slope length is the horizontal distance from the origin of overland flow to the point where either the slope gradient decreases enough that deposition begins or runoff becomes concentrated in a defined channel. Reference Agriculture Handbook 703.

(b) **Significance**. Slope length has considerable control over runoff and potential accelerated water erosion. Slope length is combined with slope gradient in erosion prediction equations to account for the effect of topography on erosion.

(c) **Measurement**. Slope length is measured from the point of origin of overland flow to the point where the slope gradient decreases enough that deposition begins or runoff becomes concentrated in a defined channel. In cropland defined channels are usually ephemeral gullies, in rare instances, near a field edge they may be a classic gully or stream. Surface runoff will usually concentrate in less than 400 feet (120 meters), although longer slope lengths of up to 1,000 feet are occasionally found. The maximum distance allowed in erosion equations is 1000 feet (305 meters). Conversion to the horizontal distance is made in the conversion process within the equation model.

Assume no support practices. Ignore practices such as terraces or diversions. Slope length is best determined by pacing or measuring in the field. Do not use contour maps to estimate slope lengths unless contour intervals are one foot or less. Slope lengths estimated from contour maps are usually too long because most maps do not have the detail to indicate all ephemeral gullies and concentrated flow areas that end the slope lengths. Refer to figures -1 through 4-10 within Ag. Handbook 703 for more landscape guidance.

(d) **Entries**. Enter the high, low, and representative values for the range for each map unit component. Enter a whole number that represents the length in meters from the point of origin of overland flow to the point of deposition or concentrated flow of the slope on which the component lies. The slope length may be fully encompassed within one map unit or it may cross several map units. The minimum value is 0, and the maximum value used in erosion equations is 305 meters.

618.54 Sodium Adsorption Ratio.

(a) Definition. Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = Na / [(Ca + Mg)/2]^{0.5}$$

(b) Significance. Soils that have values for sodium adsorption ratio of 13 or more may have an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.

(c) Measurement. The concentration of Na, Ca, and Mg ions is measured in a water extract from saturated soil paste. The procedure is method 5 described in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) Entries. Enter the high, low, and representative values to represent the range of sodium adsorption ratio as integers for each horizon. Enter "0" where the SAR is negligible. Entries range from 0 to 9999.

618.55 Soil Erodibility Factors, USLE, RUSLE2.

(a) Definition. Soil erodibility factors (Kw) and (Kf) quantify soil detachment by runoff and raindrop impact. These erodibility factors are indexes used to predict the long-term average soil loss, from sheet and rill erosion under crop systems and conservation techniques. Factor Kw applies to the whole soil, and Kf applies only the fine-earth fraction, which is the <2.0 mm fraction. The procedure for determining the Kf factor is outlined in Agriculture Handbook No. 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), USDA, ARS, 1997. The K factors in Hawaii and the Pacific Basin were extrapolated from local research. The nomograph was not used.

(b) Classes. Experimentally measured Kw factors vary from 0.02 to 0.69. For soil interpretations, the factors are grouped into 14 classes. The classes are identified by a representative class value as follows: .02, .05, .10, .15, .17, .20, .24, .28, .32, .37, .43, .49, .55, and .64.

(c) Significance. Soil erodibility factors Kw or Kf are used in erosion prediction equations USLE and RUSLE. Soil properties that influence rainfall erosion are (1) those that affect infiltration rate, movement of water through the soil, and water storage capacity and (2) those that affect dispersion, detachability, abrasion, and mobility by rainfall and runoff. Some of the most important properties are texture, organic matter content, structure size class, and subsoil saturated hydraulic conductivity.

(d) Estimates. The Kw factor is measured by applying a series of simulated rainstorms on freshly tilled plots. Direct measurement of the Kw is both costly and time consuming and has been conducted only for a few selected soils.

Reliable Kf estimates are obtained from the soil erodibility nomograph on page 11 of Agricultural Handbook 537, which is reproduced in Exhibit 618-12, or by using the soil erodibility equation.

The nomograph integrates the relationship between the Kf factor and five soil properties: (1) percent silt plus very fine sand, (2) percent sand greater than 0.10 mm, (3) organic matter content, (4) structure, and (5) saturated hydraulic conductivity. The soil erodibility equation which follows also provides an estimate of Kf.

K factor = $\{2.1 \times M^{1.14} \times 10^{-4} \times (12\text{-}a) + 3.25 \times (b\text{-}2) + 2.5 \times (c\text{-}3)\}/100$

where:

M = (percent si + percent vfs) X (100 - percent clay)

Example: For a soil with 29.0% silt, 12.3% very fine sand, and 36% clay

M = (29.0+12.3) X (100-36) = 2,643.20.

a = percent organic matter (nearest whole value) (use worse case organic matter assuming long term cultivation) (0, 1, 2, 3, or 4)

b = structure code (1, = very fine granular, 2, = fine granular, 3, = med or coarse granular, or 4 = blocky, platy, or massive)

c = profile saturated hydraulic conductivity code (1, 2, 3, 4, 5, or 6). Use the layer with the lowest Ksat RVin the permeability control section. The permeability control section is the zone from the top of the mineral soil layer being evaluated to a depth of 50cm below the top of that soil layer, but not to exceed a profile depth of 200cm. The permeability control section guarantees that a specific zone is only considered relative to the mineral soil layer being evaluated. Include the permeability of any bedrock or other non-soil layers in the permeability control section. Note that the codes were initially established using the 1951 Soil Survey Manual. The codes correspond to the following saturated hydraulic conductivity ranges:

Profile Permeability Class Code	Permeability Class of 1951	Saturated hydraulic conductivity range µm/sec	Saturated hydraulic conductivity classes 1993
6	Very slow	<0.30	very low to mod. low
5	Slow	0.30 to <1.20	mod. low
4	Slow to Mod.	1.20 to <5.00	mod. high
3	Moderate	5.00 to <15.00	mod. high to high
2	Mod. to Rapid	15.00 to <30.00	high
1	Rapid	≥30.00	high to very high

The nomograph and the equation accuracy has been demonstrated for a large number of soils in the United States. However, the nomograph and the equation may not be applicable to some soils having properties that are uniquely different from those used in developing the nomograph. For example, the nomograph does not accurately predict Kf factors for certain Oxisols in Puerto Rico or the Hawaiian Islands. In these cases, Kf factors are estimated from the best information at hand and knowledge of the potential for rainfall erosion.

When using the nomograph and the equation, care should be taken to select the organic matter curve that is most representative of the horizon being considered, assuming long term cultivation. For horizons that have organic matter >4 %, use the 4 % curve. Do not extrapolate between whole values when using the equation.

Rock or pararock fragments are not taken into account in the nomograph or the equation. If fragments are substantial, they have an armoring effect. Pararock fragments are assumed to break down with cultivation. If a soil has fragments, the Kw factor should reflect the degree of protection afforded by those fragments. Guidelines for determining Kw factors are as follows:

(1) Use the nomograph in Exhibit 618-12 or the equation to determine the Kf factor for material less than 2 mm in diameter.

(2) Use Exhibit 618-11 to convert the weight percentage of the material greater than 3 inches and of the material less than 3 inches, which is retained on the #10 sieve, to a volume percent of the whole soil that is rock fragments, specifically rock fragments >2 mm in diameter. First, find the volume percentage greater than 3 inches on the whole soil basis by taking the midpoint of the weight percentage of material greater than 3 inches and comparing the weight percentage in column 2 to the volume percentage in column 1. On that same line, move to the right to the weight percent passing #10 sieve column to find the volume percent gravel, specifically rock fragments that are 2 to 75 mm in size, on a whole soil basis. Then add the volume greater than 3 inches from column 1 and the volume gravel to find the volume percent of the whole soil that is rock fragments. Add in the percent pararock fragments on noncultivated areas.

(3) Use Exhibit 618-13 to convert the Kf value of the fraction less than 2 mm derived from the nomograph in Exhibit 618-12 or from the equation, to a Kw factor adjusted for volume of rock fragments.

If the soil on site contains more or less rock fragments than the mean of the range reported, adjustments can be made in Kf by using Exhibit 618-13. Convert the estimates of rock fragments from weight percentages to volume percentages using Exhibit 618-11, then enter Exhibit 618-13 in line with this volume percentage and find in that line the nearest value to the Kf factor. Within that column, read the Kw factor on the line with the percentage of rock fragments of the soil for which you are making the estimate. Round the factor to the closest factor class. This is the new Kw factor adjusted for rock fragments on site.

(e) **Entries**. Enter the coordinated Kw and Kf classes for each horizon posted, except organic horizons.

Acceptable entries for Kw and Kf are .02,. 05, .10, .15, .17, .20, .24, .28, .32, .37, .43, .49, .55, and .64. Soil textures that do not have rock fragments have equal Kw and Kf factors. Where rock fragments exist, Kw is always less than Kf. For example:

Depth (in)	USDA Texture	Kw	Kf
0-5	GR-L	0.20	0.32
0-5	L	0.32	0.32
0-5	GRV-L	0.10	0.32
0-46	CL	0.28	0.28
46-60	SL	0.20	0.20

Soils that have similar properties and erosivity should group in similar K classes.

618.56 Soil Erodibility Factors for WEPP.

Soil erodibility factors for WEPP include Interrill Erodibility (K_i), Rill Erodibility (K_r), and Critical Hydraulic Shear (T_c). These erodibility factors for the WEPP erosion model quantify the susceptibility of soil detachment by water. These erodibility factors predict the long-term average soil loss, which results from sheet and rill erosion under various alternative combinations of crop systems and conservation techniques.

Soil erodibility factors K_i, K_r, and T_c are factors in a continuous simulation computer model which predicts soil loss and deposition on a hillslope. Reference the NSERL Report No. 9, USDA, ARS National Erosion Research Laboratory, August 1994, documentation version 94.7. This procedure does not include data for oxidic and andic materials.

These values are quantitative and calculated using experimental equations. They are different than soil erodibility factors for USLE and RUSLE.

(a) Interrill erodibility (Ki).

(1) **Definition**. Interrill erodibility (Ki) is the susceptibility of detachment and transport of soil by water. It is the susceptibility of the soil to movement to a rill carrying runoff.

(2) **Significance**. Interrill erodibility (Ki) is a measure of sediment delivery rate to rills as a function of rainfall intensity. The Ki values for soil need to be adjusted for factors that influence the resistance of soil to detachment, such as live and dead root biomass, soil freezing and thawing, and mechanical and livestock compaction.

(3) **Measurement**. Interrill erodibility (Ki) measurements result from rainfall simulation experiments. These experiments require specialized equipment and specialized measurement techniques in a research setting.

(4) **Calculations**. Use the following equations:

For cropland soils with 30 percent or more sand:

$K_i = 2{,}728{,}000 + 192{,}100 \text{ X } (\% \text{ very fine sand})$

Very fine sand must be less than or equal to 40 percent; if very fine sand is greater, use 40 percent.

For cropland soils with less than 30 percent sand:

$K_i = 6{,}054{,}000 - 55{,}130 \text{ X } (\% \text{ clay})$

Clay must not exceed 50 percent: if clay is greater, use 50 percent.

(5) **Entries**. The computer generates entry values using the above formulas. Allowable Ki values range from 2,000,000 to 11,000,000.

(b) Rill erodibility (Kr).

(1) **Definition**. Rill erodibility (K_r) is a measure of the susceptibility of a soil to detachment by flowing water. As a rule as rill erodibility (K_r) increases, rill erosion rates increase.

(2) **Significance**. Rill erodibility (K_r) is a measure of soil susceptibility to detachment concentrated flow, and is often defined as the soil detachment per unit increase in shear stress of clear water flow. Rate of soil detachment in rills varies because of a number of factors including soil disturbance by tillage, living root biomass, incorporated residue, fragments, soil consolidation, freezing and thawing, and wheel and livestock compaction.

(3) **Measurement**. Rill erodibility (K_r) measurements result from simulated rainfall and simulated flow in a research setting. These experiments require specialized equipment and specialized measurement techniques.

(4) **Calculations**. Use the following equations:

For cropland soils with 30 percent or more sand:

K_r = 0.00197 + 0.00030 X (% very fine sand) + 0.03863 X *EXP*(-1.84 X ORGMAT)

Where:
Organic Matter (ORGMAT) is the organic matter in the surface soil (assuming that organic matter equals 1.724 times organic carbon content). Organic matter must exceed 0.35 percent; if less, use 0.35 percent.

Very fine sand must be less than or equal to 40 percent; if greater, use 40 percent.

For cropland soils with less than 30 percent sand:

K_r = 0.0069 + 0.134 X *EXP*(-0.20 X % Clay)

Where:
Clay must be 10 percent or greater; if less, use 10 percent.

(5) **Entries** The computer generates the value by using the above formulas. Allowable K_r values range from 0.002 to 0.045 s/m.

(c) **Critical shear stress (Tc).**

(1) **Definition.** Critical shear stress (Tc) is the hydraulic shear that must be exceeded before rill erosion can occur.

(2) **Significance.** Critical shear stress (Tc) is an important term in the rill detachment equation, and is the shear stress below which no soil detachment occurs. Critical shear stress (Tc) is the shear intercept on a plot of detachment by clear water versus shear stress in rills.

(3) **Measurements.** Critical hydraulic shear (Tc) is a derived variable measured in a specialized research project.

(4) **Calculations.** Use the following equations:

For cropland soils with 30 percent or more sand:

T_c = 2.67 + 0.065 X (% clay) - 0.058 X (% very fine sand)

Where:
Very fine sand must be less than or equal to 40 percent; if greater, use 40 percent.

For cropland soils with less than 30 percent sand:

Tc = 3.5

(5) **Entries.** No manual entry is needed. The value will be computer generated using the above formulas. Allowable Tc values range from 1 and 6 N/m2.

618.57 Soil Moisture Status.

(a) **Definition.** Soil moisture status is the mean monthly soil water state at a specified depth.

(b) **Classes.** The water state classes used in soil moisture status are dry, moist, and wet. These classes are defined as follows:

Water State Class	Definition
Dry	≥15 bar suction
Moist	< 15 bar to ≥ 0.0 bar (moist plus nonsatiated wet)
Wet	< 0.0 bar; free water present (satiated wet)

(c) **Significance.** Soil moisture status is a recording of the generalized water states for a soil component. Soil moisture greatly influences vegetation response, root growth, excavation difficulty, albedo, trafficability, construction, conductivity, soil chemical interactions, workability, chemical transport, strength, shrinking and swelling, frost action, seed germination, and many other properties, qualities, and interpretations. Soil moisture states are significant to soil taxonomic classification, wetland classification, and other classification systems. The recording of soil moisture states helps to document the soil classification as well as convey information for use in crop and land management models.

(d) **Measurement.** Soil water status can be measured using tensiometers or moisture tension plates. Soil water status also can be field estimated. Chapter 3 of the Soil Survey Manual provides more information. It is important to note that the 3 water state classes and 8 subclasses described in the Soil Survey Manual are used to describe the moisture state at a point in time for individual pedons (spatial and temporal point data), while the water state classes discussed here are used for estimating the mean monthly aggregated moisture conditions for a map unit component. As a consequence, only 3 classes are used, and the definitions for the moist and wet classes are modified from the Soil Survey Manual definitions. The wet class used here includes only the satiated wet class and corresponds to a free water table. The moist class is expanded to include the nonsatiated wet class of the *Soil Survey Manual.*

Dry is separated from moist at 15 bar suction. Wet satiated has a tension of 0.0 bar or less (zero or positive pore pressure)

Changes in natural patterns of water movement from dams and levees are considered in evaluating and entering soil moisture status. Infiltration, saturated hydraulic conductivity, and organic matter, which affect soil moisture movement, are strongly impacted by land cover and land use. Land use/land cover should be given consideration as a mapping tool in separating map units or map unit components. The differences in soil moisture status from land use/land cover differences constitute a difference in soil properties. However, conservation practices, such as irrigation and fallow, alter the soil moisture status but are not considered in the map unit component data. Use-dependent databases may allow entries for these altered states in the future. Permanent installations, such as drainage ditches and tile, affect soil moisture status, and the drained condition should be reflected in the soil moisture status entries for map unit components that are mapped as "drained." Undrained areas are mapped as "undrained" components and the entries for soil moisture status reflect the undrained condition.

Irrigation and drainage canals are shown on soil maps; their effects on the soil should be shown in the properties of the soils in mapping and in the property records. Soils that are now wet because of excessive irrigation and leaking canals should be mapped, and their properties should reflect the current soil moisture status.

(e) **Guiding Concepts**

(1) The intent is to describe a mean moisture condition, by month, for a soil component. Layer depths may or may not be the same as horizon depths in the component horizon table. Layers define the zone having the same soil moisture state. If the soil is wet throughout 0 to 200 cm, then one entry (wet) is made for 0 to 200 cm for that month.

(2) For frozen soils enter the appropriate soil moisture state that the soil would have if thawed. For example, if the soil is frozen and you determine it is wet when thawed, enter wet.

(3) The layers can be subdivided into various soil moisture states as needed, but remember that these are monthly averages for the extent of the component across the landscape.

(4) The entries are expected to come from the best estimates that local knowledge can provide. If local knowledge is supported by data, so much the better. The information as aggregated data is not expected to be exact but to be generalized and to reflect an average condition.

(5) Entries for RV are to reflect the conditions of a "normal year."

(6) Make entries for each month by layer. Enter the condition that dominates for the month. This is the condition for more than 15 days on the long-term average. The low and high values represent the depth range within the component for the normal year; they are not to represent the extremes, such as years of drought.

(7) If the depth to free-water fluctuates during the month, use the depth for the average between the high and low level.

(8) Exhibit 618-18 contains examples of entries.

(f) **Entries.** Enter the soil moisture status with dry, moist, or wet, for each soil layer for each month. Enter only one soil moisture state within a given layer. The number of layers depends upon the number of changes of soil moisture status in the profile.

Enter the value for soil moist depth to top that represents the distance, in whole centimeters, from the soil surface to the top of each soil layer for each month.

618.58 Soil Slippage Hazard.

(a) **Definition.** Soil slippage hazard is the observation of surface slippage features that indicate a mass of soil will possibly slip when the vegetation is removed and soil water is at or near saturation or when the slope is undercut. Saturating a slope with water from altered drainage or irrigation has an effect on slippage hazard but is not considered when making these ratings.

The publication "Landslides Investigation and Mitigation Special Report 247 Transportation Research Board National Research Council 1996" provides additional information on landscape slippage.

(b) **Significance.** Slippage is an important consideration for engineering practices, such as constructing roads and buildings, and for forestry practices.

(c) Estimates. Soil slippage hazard classes are estimated by observing slope; lithology, including contrasting lithologies; strike and dip; surface drainage patterns; and occurrences of such features as slip scars and slumps.

(d) Guides. Use Exhibit 618-17 "Key Landforms and Their Susceptibility to Slippage" as a guide for rating soil slippage hazard.

(e) Entries. Enter one of the following classes:

High - (Unstable)

Medium - (Moderately unstable)

Low - (Slightly unstable to stable)

618.59 Soil Temperature.

(a) Definition. Soil temperature is the mean monthly soil temperature at the specified depth. (The average of the daily high and daily low temperature for the month.)

(b) Significance. Soil temperature is important to many biological and physical processes that occur in the soil. Plant germination and growth are closely related to soil temperature. Cold soil temperatures effectively create a thermal pan in the soil. Roots cannot uptake moisture or nutrients below the threshold temperatures specific to plant species. Chemical reactions are temperature sensitive. Pesticide breakdown, residue breakdown, microbiological activity in the soil, and nutrient conversions relate to soil temperature. Soil temperature gradients affect soil moisture and salt movement. Soil temperatures below freezing especially affect soil saturated hydraulic conductivity, excavation difficulty, and construction techniques. Soil temperature is used in soil classification and hydric soil determinations. Additional information is provided in Chapter 3 of the Soil Survey Manual.

(c) Estimates. Soil temperature according to depth can be estimated from measured soil temperatures in the vicinity. Air temperature fluctuations, soil moisture, aspect, slope, color, snow cover, plant cover, and residue cover affect soil temperature. Estimates of soil temperature should take these factors into account when soil temperatures are extrapolated from one soil map unit component to another.

(d) Measurement. Soil temperature can be measured by many types of thermometers, including mercury, bimetallic, thermisters, and thermocouples. Many types of thermometers can be configured for remote, unattended operation.

(e) Entries. Each soil temperature layer consists of a zone bounded by a five degree increment; e.g., 0-5, 5-10, 10-15. The allowable range is -10.0 to 50.0 degrees Celsius. The number of layers depends upon the number of changes of soil temperature status in the profile.

Enter the value for soil temperature mean monthly using the average soil temperature Celsius increment that corresponds to each soil temperature layer for each month.

Enter the value for soil temperature depth to top that represents the distance, in centimeters, from the soil surface to the top of each soil temperature layer for each month. Enter the value for soil temperature depth to bottom that represents the distance, in centimeters, from the soil surface to the bottom of each soil temperature layer for each month.

618.60 Subsidence, Initial and Total.

(a) Definition. Subsidence is the decrease in surface elevation as a result of the drainage of wet soils that have organic layers or semifluid, mineral layers. Initial subsidence is the decrease of surface elevation that occurs within the first 3 years of the drainage of these wet soils. Total subsidence is the potential decrease of surface elevation as a result of the drainage of these wet soils.

(b) Significance. The susceptibility of soils to subsidence is an important consideration for organic soils that are drained. If these soils are drained for community development, special foundations are needed for buildings. Utility lines, sidewalks, and roads that lack special foundations may settle at different rates, thus causing breakage, high maintenance costs, and inconvenience. If the soils are drained for farming, the long-term effects of subsidence, the possible destruction of land if it subsides below the water table, and possible legal implications if the soils are in wetlands must be considered.

Subsidence, as a result of drainage is attributed to (1) shrinkage from drying, (2) consolidation because of the loss of ground-water buoyancy, (3) compaction from tillage or manipulation, (4) wind erosion, (5) burning, and (6) biochemical oxidation. The first three factors are responsible for the initial subsidence that occurs rapidly, specifically, within about 3 years after the water table is lowered. After the initial subsidence, a degree of stability is reached and the loss of elevation declines to a steady rate primarily because of oxidation. The oxidation and subsidence continues at this slower rate until stopped by the water table or underlying mineral material. The rate of subsidence depends on (1) ground-water depth, (2) amount of organic matter, (3) kind of organic matter, (4) soil temperature, (5) pH, and (6) biochemical activity.

(c) Estimates. A number of studies have been made to measure actual subsidence. Other useful studies have measured the bulk density of organic soils after drainage. Based on these studies, some general guidelines can be given for initial and total subsidence.

<u>Initial subsidence</u>, generally is about half of the depth to the lowered water table or to mineral soil, whichever is shallower. It occurs within about 3 years after drainage. Total subsidence is the total depth to the water table or the thickness of the organic layer, whichever is shallower. It is rarely reached except where organic layers are thin or where drainage systems have been installed for a long time.

(d) Measurement. After organic soils have been drained and cultivated for a number of years, they reach a nearly steady rate of subsidence that is reflected by the rather stable bulk density. Unpublished studies by the Soil Survey Laboratory, have shown that the bulk density of the organic component, such as that with the percent mineral calculated out, stabilizes at around 0.27 g/cc for surface layers and 0.18 g/cc for subsurface layers. These values can be used to calculate the amount of subsidence at some time in the future as compared to the thickness of soil at the time of observation or measurement. The procedure is as follows:

(1) Sample the surface and subsurface layers for field state bulk density. Methods are described in the Handbook of Soil Survey Investigations Field Procedures, I 4-2, 1971, USDA, SCS, and Method 4A as described in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(2) Calculate out the weight contribution of the mineral component to obtain the bulk density of the organic component (DbOM). This manipulation allows bulk densities to be on a common base so that various layers can be compared. The formula for the computation is as follows:

DbOM = Db (1 - percent mineral/100), where Db is the field state bulk density.

(3) Calculate the subsidence percent (SP) for surface and subsoil horizons as follows:

For surface horizons:
SP = 100 - [(DbOM/0.27) x 100]

For subsurface horizons:
SP = 100 - [(DbOM/0.18) x 100]

Where DbOM is obtained from step (2).

(4) Convert initial subsidence percent to depth of subsidence in inches as follows:

Where:

S	=	SPsur x Tsur + SPsub x Tsub
S	=	depth of subsidence in inches
SPsur	=	subsidence percent of the surface horizon
Tsur	=	thickness of the surface horizon
SPsub	=	subsidence percent of the subsurface horizon
Tsub	=	thickness of the subsurface horizon above the water table or the mineral soil, whichever is shallower

(e) **Entries**. Enter the high, low, and representative values, in whole numbers that represent the range for initial and total subsidence in centimeters for the map unit component. Allowable entries range from 0 to 999. If subsidence is not a concern, enter "0".

618.61 Surface Fragments.

(a) **Definition.** Surface fragments are unattached, cemented pieces of bedrock or bedrock-like material 2 mm or larger that are exposed at the surface of the soil.

Surface fragments can be either rock fragments or pararock fragments, which are defined in part 618.28. Vegetal material is not included.

(b) **Surface fragment cover percent.**

(1) **Definition**. Surface fragment cover percent is the percent of ground covered by fragments 2 mm or larger.

(2) **Significance**. Fragments on the soil surface are used as map unit phase criteria and greatly affect use and management of the soil. They affect equipment use, erosion, excavation, and construction. They act as a mulch, slowing evaporation and armoring the soil from rainfall impact. They also affect the heating and cooling of soils.

(3) **Estimates.** An estimation of cover by surface fragments can be made visually without quantitative measurement, by transect techniques, or by some combination of visual and quantitative measures. Chapter 3 of the Soil Survey Manual provides more information.

(4) **Entries**. Enter the high, low, and representative values for the percent of the surface covered by each size class and the kind of fragment described for each map unit component.

(c) **Surface fragment kind.**

(1) **Definition.** Surface fragment kind is the lithology/composition of the surface fragments 2mm or larger.

(2) **Significance.** Fragments vary according to their resistance to weathering. Consequently, fragments of some lithologies are more suited than others for use as building stone, road building material, or riprap to face dams and stream channels.

(3) **Entries.** Enter the appropriate class name for the kind of fragment present. More than one choice may be entered. The class names can be found in the NASIS data dictionary.

(d) **Surface fragment size.**

(1) **Definition**. Surface fragment size is the size based on the multiaxial dimensions of the surface fragments.

(2) **Significance.** The size of surface fragments is significant to the use and management of the soil. The adjective form of fragment size is used as phase criteria for naming map units. It affects equipment use, excavation, construction, and recreational uses.

(3) **Classes.** Classes of surface fragment size are subdivided according to flat and non-flat fragments.

Flat fragment classes are:

Flat fragment class	**Length of fragment (mm)**
Channers	2-150
Flagstones	150-380
Stones	380-600
Boulders	≥600

Non-flat fragment classes are:

Non-flat fragment class	**Diameter (mm)**
Pebbles	2-75
Fine pebbles	2-5
Medium pebbles	5-20
Coarse pebbles	20-75
Cobbles	75-250
Stones	250-600
Boulders	≥600

For fragments that are less than strongly cemented, "para" is added as a prefix to the above terms; i.e., paracobbles.

(4) **Entries.** Enter the minimum, maximum, and representative values, in whole numbers, of each size class described. Entries are in millimeters and range from 2 to 3,000 mm.

(e) Mean distance between rocks.

(1) Definition. Mean distance between rocks is the average distance between surface stones and/or boulders.

(2) Significance. The mean distance between rocks is a field clue for naming stony or bouldery map units. The closer the distance, the more equipment limitations for harvesting forestland or soil cultivation.

(3) Estimates. Table 3-12 of the Soil Survey Manual shows the distance between stones and boulders if the diameter is 0.25 m, 0.6 m, or 1.2 m. This table should be used with caution because stones and boulders will rarely be equally spaced or have the same diameter.

(4) Entries. Enter the high, low, and representative values for the mean distance in hundredths of meters.

(f) Surface fragment roundness.

(1) Definition. Surface fragment roundness is an expression of the sharpness of edges and corners of surface fragments.

(2) Classes. The surface fragment roundness classes are:

Angular
Subangular
Subrounded
Rounded
Well-rounded

(3) Entries. Enter the appropriate class name for the roundness class(es) present. A representative value may be designated.

(g) Surface fragment rupture resistance cemented.

(1) Definition. Surface fragment rupture resistance cemented is the rupture resistance of a surface fragment of specified size that has been air dried and then submerged in water.

(2) Measurements. Procedures and classes of cementation are listed with the rupture resistance classes. Classes are described for similar specimens about 25-30 mm on edge, which are air-dried and then submerged in water for at least 1 hour. The specimen is compressed between extended thumb and forefinger, between both hands, or between the foot and a hard flat surface. If the specimen resists compression, a weight is dropped onto it from progressively greater heights until it ruptures. Failure is considered at the initial detection of deformation or rupture. Stress applied in the hand should be over a 1-second period. The tactile sense of the class limits may be learned by applying force to top loading scales and sensing the pressure through the tips of the fingers or through the ball of the foot. Postal scales may be used for the resistance range that is testable with the fingers. A bathroom scale may be used for the higher rupture resistance range.

(3) Significance. The rupture resistance is significant where the class is strongly cemented or higher. These classes can impede or restrict the movement of soil water vertically through the soil profile and have a direct impact on the quality and quantity of ground water and surface water.

(4) **Classes.** The classes are:

Extremely weakly
Very weakly
Weakly
Moderately
Strongly
Very strongly
Indurated

(5) **Entries.** Enter the appropriate class name(s) for each class of fragment present. A representative value may be designated.

(h) **Surface fragment shape.**

(1) **Definition.** Surface fragment shape is a description of the overall shape of the surface fragment.

(2) **Classes.** The surface fragment shape classes are:

Flat
Nonflat

(3) **Entries.** Enter the appropriate class name(s) for each class present. Multiple entries may be made. A representative value may be designated.

618.62 T Factor.

(i) **Definition.** The T factor is the soil loss tolerance (in tons per acre). It is defined as the maximum amount of erosion at which the quality of a soil as a medium for plant growth can be maintained. This quality of the soil to be maintained is threefold in focus. It includes maintaining (1) the surface soil as a seedbed for plants, (2) the atmosphere-soil interface to allow the entry of air and water into the soil and still protect the underlying soil from wind and water erosion, and (3) the total soil volume as a reservoir for water and plant nutrients, which is preserved by minimizing soil loss. Erosion losses are estimated by USLE and RUSLE2.

(j) **Classes.** The classes of T factors are 1, 2, 3, 4, and 5.

(k) Significance. Soil loss tolerances commonly serve as objectives for conservation planning on farms. These objectives assist in the identification of cropping sequences and management systems that will maximize production and also sustain long-term productivity. T factors represent the goal for maximum annual soil loss.

(l) **Guidelines.** Conservation objectives for soil loss tolerance include on maintaining a suitable seedbed and nutrient supply in the surface soil, maintaining an adequate depth and quality of the rooting zone, and minimizing unfavorable changes in water status throughout the soil. A single T factor is assigned to each map unit component.

(m) **Estimates.** The T factor is assigned to soils without respect to land use or cover. T factors are assigned to compare soils and do not imply differences to vegetation response directly. Many of the factors used to assign a T factor are also important to vegetation response, but the T factor is not assigned to imply vegetation sensitivity to all vegetation. The general guideline given in Exhibit 618-14 is used to assign T factors but more specific criteria is used to select limiting soil properties.

(n) Entries. The estimated soil loss tolerance should be calculated from the soil properties and qualities posted in the database for each map unit component based generally on the guideline, given in Exhibit 618-14. Acceptable values are 1, 2, 3, 4, or 5.

618.63 Taxonomic Family Temperature Class.

(a) Definition. The soil temperature classes are part of the family level in Soil Taxonomy. They differ from "Soil temperature regimes," (Data Element: taxonomic temp regime), in that the "cryic", and "pergelic" temperature regimes are divided between the frigid and isofrigid classes based on differences in mean winter and mean summer soil temperatures. Soil temperature classes are based on mean annual and mean seasonal soil temperatures using the Celsius (centigrade) scale and taken either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower.

For soil families that have a difference of 5°C or more between mean summer (June, July, and August in the northern hemisphere) temperature and mean winter (December, January, and February in the northern hemisphere) temperature, the soil temperature classes, defined in terms of the mean annual soil temperature, are as follows:

Frigid	Lower than 8°C
Mesic	8°C to 15°C
Thermic	15°C to 22°C
Hyperthermic	22°C or higher

For soil families that have a difference of less than 5°C between the mean summer and mean winter soil temperatures, the soil temperature classes, defined in terms of the mean annual soil temperature, are as follows:

Isofrigid	< 8°C
Isomesic	8°C to 15°C
Isothermic	15°C to 22°C
Isohyperthermic	22°C or higher

(b) Significance. All soils have a taxonomic soil temperature class. Soil temperature classes are used as family differentiae in all orders in Soil Taxonomy. The names are used as part of the family name unless the criteria for a higher taxon carry the same limitation. The frigid or isofrigid class is implied in all boric and cryic suborders and great groups, but the class is not used as part of the family name because it would be redundant.

(c) Estimates. Estimates of soil temperature classes are made with models that use climatic data including mean annual and mean seasonal air temperatures, precipitation, and evapotranspiration. Some models include snow cover, topographic, and vegetative inputs.

(d) Measurement. The Celsius (centigrade) scale is the standard. It is assumed that the temperature is that of a nonirrigated soil. The soil temperature classes are based on long term averages of mean annual and mean seasonal soil temperatures taken either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower.

(e) Entries. Enter the appropriate soil temperature class from the following list:

Frigid	Hyperthermic
Isofrigid	Isomesic
Isothermic	Isohyperthermic
Mesic	Thermic

618.64 Taxonomic Moisture Class.

(a) Definition. Soil moisture classes refer to the moisture regimes defined in soil taxonomy. Soil moisture regimes are defined by the presence or absence either of ground water or of water held at a tension of less than 1500 kPa, in the soil or in specific horizons, by periods of the year.

(b) Significance. All soils have a soil moisture regime. Soil moisture regimes are used as differentiae in all orders, except Histosols, in soil taxonomy. The moisture regime is used for making interpretations for wildlife habitat. The moisture regime of some soils is not apparent in the classification given in soil taxonomy. Ustolls and Xerolls, for example, can have an aridic moisture regime. Some soils can have more than one moisture regime. An example is a soil that meets the requirements of the aquic moisture regime in the wet season and also meets the requirements of the ustic regime.

(c) Estimates. Estimates of soil moisture regimes are made with models that use climatic data, including mean annual and mean seasonal air temperatures, precipitation, and evapotranspiration. Some models include topographic and vegetative inputs. The soil moisture control section, also defined in soil taxonomy, is used to facilitate estimation of soil moisture regimes.

(d) Measurement. The soil moisture regimes are based on annual and seasonal soil moisture measurements taken in the soil moisture control section. The soil should not be irrigated or fallowed or influenced by other moisture altering practices.

(e) Entries. Enter the appropriate soil moisture regimes from the following list:

Aquic	Peraquic
Aridic (torric)	Udic
Perudic	Ustic
Xeric	

618.65 Taxonomic Moisture Subclass. (Subclasses of soil moisture regimes.)

(a) Definition. Subclasses of soil moisture regimes are defined at the subgroup level in soil taxonomy. The criteria differ among the great groups. For example aquic, aridic, and udic are subclasses of the soil moisture regime in Haplustalfs. A subclass is entered for all soils in a great group that meet the subclass criteria, even if the subclass is not part of the taxonomic classification. For example, aquic, aridic, udic, or typic should be used as a subclass of the soil moisture regime in Lithic Haplustalfs if the criteria are met.

(b) Significance. Subclasses of soil moisture regimes are used at the subgroup level in all orders in Soil Taxonomy except Histosols. They typically indicate an intergrade between two moisture regimes that affect the use and management of the soil. Subclasses of soil moisture regimes are used for making interpretations for wildlife habitat.

(c) Estimates. Estimates of subclasses of soil moisture regimes are made with models that use climatic data, including mean annual and mean seasonal air temperatures, precipitation, and evapotranspiration. Some models include topographic and vegetative inputs. The soil moisture control section, also defined in soil taxonomy, is used to facilitate estimation of some subclasses of soil moisture regimes.

(d) Measurement. The subclasses of soil moisture regimes are based on annual and seasonal soil moisture measurements taken in the soil moisture control section. The soil should not be irrigated or fallowed or influenced by other moisture altering practices.

(e) Entries. Enter the appropriate subclass of soil moisture regimes from the following list:

Aeric	Anthraquic
Aquic	Aridic (torric)
Oxyaquic	Typic
Udic	Ustic
Xeric	

618.66 Taxonomic Temperature Regime. (Soil Temperature Regimes.)

(a) Definition. Soil temperature regimes refer to the temperature regimes as defined in soil taxonomy.

(b) Significance. Soil temperature regimes are used as differentiae above the family level in all orders in soil taxonomy. (Soil temperature classes, defined above, are used as family differentiae.) Soil temperature regimes greatly affect the use and management of soils, particularly for the selection of adapted plants. They are used for making interpretations for wildlife habitat.

(c) Estimates. Estimates of soil temperature regimes are made with models that use climatic data including mean annual and mean seasonal air temperatures, precipitation, and evapotranspiration. Some models include topographic and vegetative inputs.

(d) Measurement. The soil temperature regime is based on mean annual and seasonal soil temperatures using the Celsius (centigrade) scale and taken either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower.

(e) Entries. Enter the appropriate soil temperature regimes from the following list:

Pergelic	Cryic
Frigid	Mesic
Thermic	Hyperthermic
Isofrigid	Isomesic
Isothermic	Isohyperthermic

618.67 Texture Class, Texture Modifier, and Terms Used in Lieu of Texture.

(a) Definition. Texture class refers to the soil texture classification used by the U.S. Department of Agriculture as defined in the Soil Survey Manual. Soil texture is the relative proportion, by weight, of the particle separate classes finer than 2 mm in equivalent diameter. The material finer than 2 mm is the fine-earth fraction. Material 2 mm or larger is rock or pararock fragments.

Click Interactive Online Soil Texture Calculator to enter the percent sand and clay, and let the calculator do the rest.

(b) Significance. Soil texture influences engineering works and plant growth and is used as an indicator of how soils formed. Soil texture has a strong influence on soil mechanics and the behavior of soil when it is used as construction or foundation material. It influences such engineering properties as bearing strength, compressibility, saturated hydraulic conductivity, shrink-swell potential, and compaction. Engineers are also particularly interested in rock and pararock fragments. Soil texture influences plant growth by its affect on aeration, the water intake rate, the available water capacity, the cation exchange capacity, saturated hydraulic conductivity, erodibility, and workability. Changes in texture as related to depth are indicators of how soils formed. When texture is plotted with depth, smooth curves indicate translocation and accumulation. Irregular changes in particle-size distribution, especially in the sand fraction, may indicate lithologic discontinuities, specifically, differences in parent material.

(c) Measurement. USDA texture can be measured in the laboratory by determining the proportion of the various size particles in a soil sample. The analytical procedure is called particle-size analysis or mechanical analysis. Stone, gravel, and other material 2 mm or larger are sieved out of the sample and do not enter into the analysis of the sample. Their amounts are measured separately. Of the remaining material smaller than 2 mm, the amount of the various sizes of sand is determined by sieving. The amount of silt and clay is determined by a differential rate of settling in water. Either the pipette or hydrometer method is used for the silt and clay analysis. Organic matter and dissolved mineral matter are removed in the pipette procedure but not in the hydrometer procedure. The two procedures are generally very similar, but a few samples, especially those with high organic matter or high soluble salts, exhibit wide discrepancies. The detailed procedures are outlined in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004, USDA, NRCS.

(d) Estimates. The determination of soil texture of the less than 2 mm material is made in the field mainly by feeling the soil with the fingers. The soil must be well moistened and rubbed vigorously between the fingers for a proper determination of textural class by feel. This method requires skill and experience but good accuracy can be obtained if the field soil scientist frequently checks his or her estimates against laboratory results. Many NRCS offices collect reference samples for this purpose. The content of particles larger than 2 mm cannot be evaluated by feel. The content of the fragments is determined by estimating the proportion of the soil volume that they occupy. Fragments in the soil are discussed in part 618.28.

Each soil scientist must develop the ability to determine soil texture by feel for each genetic soil group according to the standards established by particle-size analysis. Soil scientists must remember that soil horizons that are in the same texture class but are in different subgroups or families may have a different feel. For example, natric horizons generally feel higher in clay than "non-natric" horizons. Laboratory analysis generally shows that the clay in natric horizons is less than the amount estimated from the field method. The scientist needs to adjust judgment and not the size distribution standards.

A detailed discussion of field determination of soil texture is on page I-2.5-1 in the Handbook of Soil Survey Investigations Field Procedures, USDA, Natural Resources Conservation Service.

(e) Entries. Texture is displayed by the use of five data elements in NASIS -- texture class, texture modifier, texture modifier and class, stratified texture flag, and terms used in lieu of texture.

As many as four entries can be made for each horizon for each of these data elements. However, only one texture for a surface horizon should be entered for each component. Only use multiple textures if they interpret the same for the horizon. Only textures that represent complete horizons should be entered. A representative value is also identified for each horizon. This choice should match the representative values of the various soil particle size separates posted elsewhere in the database.

(f) Texture class.

(1) Definition. Texture class is an expression, based on the USDA system of particle sizes, for the relative portions of the various size groups of individual mineral soil grains less than 2 mm equivalent diameter in a mass of soil.

Each texture class has defined limits for each particle separate class of mineral particles less than 2 mm in effective diameter. The basic texture classes, in the approximate order of increasing proportions of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further subdivided into coarse, fine, or very fine. The basic USDA texture classes are given graphically in Exhibit 618-8 as a percentage of sand, silt, and clay. The chart at the bottom of the figure shows the relationship between the particle size and texture classes among the AASHTO, USDA, and Unified Soil Classification systems.

(2) Entries. Enter the texture class code(s) for each horizon using Exhibit 618-15.

(g) Terms used in lieu of texture.

(1) Definition. Terms used in lieu of texture are substitute terms applied to materials that do not fit into a texture class because of organic matter content, size, rupture resistance, or another reason. Examples include muck,, gravel, and bedrock. Exhibit 618-15 provides a list of these terms and their codes. Some of these terms may be modified with terms from the list of texture modifiers, such as cemented material, code CEM MAT.

(2) Application.

(i) The terms used in lieu of texture highly decomposed plant material, moderately decomposed plant material, and slightly decomposed plant material (codes HPM, MPM, and SPM), should only be used to describe near surface horizons composed of plant material in various stages of decomposition that are saturated with water for less than 30 cumulative days in normal years (and are not artificially drained). The terms muck, mucky peat, and peat (codes MUCK, MPT and PEAT) should be used to describe histic epipedons and organic horizons of any thickness that are saturated with water for 30 or more cumulative days in normal years (or are artificially drained), including those in Histels and Histosols, except for Folists.

(ii) Material, which uses the code MAT, is generic and requires the use of a texture modifier. Texture modifier terms, such as ashy, coprogenous, gypsiferous, and marly, are used to describe material.

(3) Entries. Enter the applicable code(s) for each horizon as appropriate.

(h) Texture modifier.

(1) Definition. Texture modifier is a term used to denote the presence of a condition or component other than sand, silt, or clay..

(2) Application. Texture modifier terms may apply to both texture and terms used in lieu of texture. Some may apply to both, others only apply to one or the other. Combinations of some texture modifiers are allowed. A list of allowable texture modifier terms and their codes is given in Exhibit 618-15. Some rules of application are given below.

(i) If the content of fragments equals 15 percent or more by volume, texture modifiers are used. An example is gravelly loam or parachannery loam. The terms very and extremely are used when the content of fragments equals 35 to less than 60 percent, and 60 to less than 90 percent, by volume, respectively.

(ii) "Mucky" and "peaty" are used to modify near surface horizons of mineral soils that are saturated with water for 30 or more cumulative days in normal years (or are artificially drained). An example is mucky loam. Excluding live roots, the horizon has an organic carbon content (by weight) of:

- 5 to < 12 percent if the mineral fraction contains no clay; or
- 12 to < 18 percent if the mineral fraction contains 60 percent or more clay; or
- (5 + (clay percentage multiplied by 0.12)) to < (12 + (clay percentage multiplied by 0.10)) if the mineral fraction contains less than 60 percent clay.

(iii) "Highly organic" is used to modify near surface horizons of mineral soils that are saturated with water for less than 30 cumulative days in normal years (and are not artificially drained). Excluding live roots, the horizon has an organic carbon content (by weight) of:

- 5 to < 20 percent if the mineral fraction contains no clay; or
- 12 to < 20 percent if the mineral fraction contains 60 percent or more clay; or
- (5 + (clay percentage multiplied by 0.12)) to < 20 percent if the mineral fraction contains less than 60 percent clay.

(iv) When modifying the texture of soils with greater than 15 percent by volume artifacts, the following classes, are used:

Less than 15 percent:	No texture modifier terms are used.
15 to < 35 percent:	The adjectival term "artifactual" is used as a modifier of the textural term: "artifactual loam".
35 to < 60 percent:	The adjectival term "very artifactual" is used as a modifier of the textural term: "very artifactual loam".
60 percent or more:	If enough fine earth is present to determine the textural class (approximately 10 percent or more by volume) the adjectival term "extremely artifactual" is used as a modifier of the textural term: "extremely artifactual loam".

If there is too little fine earth to determine the textural class (less than about 10 percent by volume) the term "artifactual material," is used.

In some instances, the soil may contain a combination of both artifacts and rock fragments. In these cases, the rock fragments and artifacts are described separately. Where appropriate, compound texture modifiers can be used, with the modifier for artifacts coming before the modifier for rock fragments: "artifactual very gravelly sandy loam"; "very artifactual channery mucky clay".

(v) Compound texture modifiers may be used, such as a term used to indicate the presence of fragments and another used to indicate some non-fragment condition. The term used to indicate fragments should be listed first. An example is very gravelly mucky silt loam or paragravelly ashy loam.

(vi) Texture modifiers, such as paragravelly and paracobbly, are used to identify the presence of pararock fragments. The size, shape, and amounts of pararock fragments required for these terms are the same as for rock fragments.

(vii) When a horizon includes both rock and pararock fragments, use the following for selecting textural modifiers:

- Describe the individual kinds and amounts of rock and pararock fragments.
- Do not use a fragment textural modifier when the combined volume of rock and pararock fragments is less than 15 percent.
- When the combined volume of rock and pararock fragments is more than 15 percent, and the volume of rock fragments is less than 15 percent, assign pararock fragment modifiers based on the combined volume of fragments. For example, use paragravelly as a textural modifier for soils with 10 percent rock and 10 percent pararock gravel sized fragments.
- When the volume of rock fragments is 15 percent or greater, use the appropriate textural modifier for rock fragments (Exhibit 618-11), regardless of the volume of pararock fragments. (Do not add the volume of rock and pararock fragments to determine the textural modifier).

(viii) The following definitions of texture modifiers guide their usage:

- Hydrous -- material that has andic soil properties and an undried 15 bar water content of 100 percent or more of the dry weight.
- Medial -- material that has andic soil properties and has a 15 bar water content of less than 100 percent on undried samples and of 12 percent or more on air-dried samples.
- Ashy -- material that is neither hydrous nor medial, and the fine earth fraction contains 30 percent or more particles 0.02 to 2.0 mm in diameter, of which 5 percent or more is composed of volcanic glass; and the [(aluminum plus 1/2 iron percent by ammonium oxalate) times 60] plus the volcanic glass percent is equal to or more than 30.
- Gypsiferous -- material that contains 15 percent or more by weight gypsum.

(ix) Woody, grassy, mossy, and herbaceous texture modifiers are only used to modify muck, peat, or mucky peat terms (histic epipedons and organic horizons of any thickness that are saturated with water for 30 or more cumulative days in normal years (or are artificially drained), including those in Histels and Histosols, except for Folists).

- Woody –
  (a) any material that contains 15 percent or more wood fragments larger than 2 cm in size; or
  (b) -- organic soil materials, other than SPM, MPM, or HPM, that contains 15 percent or more fibers that can be identified as wood origin and contain more wood fibers than any other kind of fiber.
- Grassy -- organic soil material that contains more than 15 percent fibers that can be identified as grass, sedges, cattails, and other grass-like plants and contains more grassy fibers than any other kind of fiber.

- Mossy -- organic soil material that contains more than 15 percent fibers that can be identified as moss and contains more moss fibers than any other kind of fiber.
- Herbaceous -- organic soil material that contains more than 15 percent fibers that can be identified as herbaceous plants other than moss and grass or grass-like plants and more of these fibers than any other kind of fiber.

(x) Some materials can be described by utilizing an apparent texture, even though they do not fit the requirements of texture. These materials use a texture modifier. Examples are marly silt loam and gypsiferous sand.

(xi) Limnic materials are used as modifiers to texture to describe the origin or the material. These materials were deposited in water by precipitation or through the action of aquatic organisms or derived from plants and organisms. These modifiers are used to indicate presence and origin without respect to any set amount. Refer to the Keys to Soil Taxonomy for complete definitions of limnic materials.

- Coprogenous -- Coprogenous-earth or sedimentary peat is limnic layer which contains many very small (0.1 to .001mm) fecal pellets..
- Diatomaceous -- Diatomaceous-earth is a limnic layer composed of diatoms.
- Marly -- Marl is a limnic layer that is light colored and reacts with HCl.

(xii) Permanently frozen -- Term applied to soil layer in which the temperature is perennially at or below 0 degrees C, whether its consistence is very hard or loose.

(3) Entries. Enter the applicable texture modifier code(s). Multiple texture modifiers may be used in some cases.

(i) Texture modifier and class.

(1) Definition. Texture modifier and class is a concatenation of texture modifier and texture class.

This data element indicates the full texture classification of the horizon. If texture modifiers are used, they are attached to the texture class by a hyphen, for example, GR-SL. If a layer is stratified, enter SR as a texture modifier and the end members of the textural range and connect them by hyphens, for example, SR-C-L and SR-GR-S-GR-C.

(2) Entries. Enter the appropriate designation for each horizon.

(j) Stratified texture flag.

(1) Application. Stratified texture flag is used to identify stratified textures.

(2) Entries. An entry of "yes" indicates the textures are stratified. The default entry is "no."

618.68 Water, One-Tenth Bar.

(a) Definition. Water one-tenth bar is the amount of soil water retained at a tension of 1/10 bar, expressed as a percentage of < 2 mm, oven-dry soil weight.

(b) Significance. Water retained at one-tenth bar is significant in the determination of soil water-retention difference, which is used as the initial estimation of available water capacity for some soils.

(c) Measurement. Measurement in the laboratory is done on natural clods using method 4B1c. Measurement for nonswelling soils, loamy sand or coarser soils, and some sandy loams is done using method 4B1a.

(d) Entries. Enter the low, high, and representative values for the horizon. The range of valid entries is 0.00 to 999.00 percent. Tenths of a percent are allowable.

618.69 Water, One-Third Bar.

(a) Definition. Water one-third bar is the amount of soil water retained at a tension of 1/3 bar, expressed as a percentage of < 2 mm, oven-dry soil weight.

(b) Significance. Water retained at one-third bar is significant in the determination of soil water-retention difference, which is used as the initial estimation of available water capacity for some soils.

(c) Measurement. Measurement in the laboratory on natural clods uses method 4B1c. Measurement for nonswelling soils, loamy sand or coarser soils, and some sandy loams is done using method 4B1a.

(d) Entries. Enter the low, high, and representative values for the horizon. The range of valid entries is 0.00 to 999.00 percent. Tenths of a percent are allowable.

618.70 Water, 15 Bar.

(a) Definition. Water 15 bar is the amount of soil water retained at a tension of 15 bars, expressed as a percentage of < 2 mm, oven-dry soil weight.

(b) Significance. Water retained at 15 bar is significant in the determination of soil water-retention difference, which is used as the initial estimation of available water capacity for some soils. Water retained at 15 bar is an estimation of the wilting point. It is also used to estimate clay in poorly dispersed soils in soil taxonomy.

(c) Measurement. Measurement in the laboratory is done using method 4B2a.

(d) Entries. Enter the low, high, and representative values for the horizon. The range of valid entries is 0.00 to 220.00 percent. Tenths of a percent are allowable.

618.72 Water, Satiated.

(a) Definition. Water, satiated, is the estimated volumetric soil water content at or near zero bar tension, expressed as a percentage of the less than 2 mm fraction of the soil.

(b) Significance. Water, satiated, represents the total possible water content of the soil, including the amount in excess of field capacity, and is used to estimate the amount of water available for leaching and translocation. Satiated water content approximates the water content for the fine-earth fraction at saturated conditions. It is used in such resource assessment tools as Soil Hydrology, Water Budgets, Leaching, and Nutrient/Pesticide Loading models. Correction for fragments may be needed when applied to various models since the entry is for the < 2mm fraction.

(c) Estimation. The values are derived by the following formula:

(1) Satiated water % = total porosity % - entrapped air %

(2) Total porosity % = 100(1-bulk density moist/particle density)

(3) Assume approximately 3% entrapped air.

(d) Entries. Enter the high, low, and representative values, as whole integers for the horizon. The range of valid entries is 25 to 80 percent.

618.71 Wind Erodibility Group and Index.

(a) Definition. A wind erodibility group (WEG) is a grouping of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to blowing. The Wind Erodibility Index (I), used in the wind erosion equation, is assigned using the wind erodibility groups.

(b) Significance. There is a close correlation between soil blowing and the size and durability of surface clodiness, fragments, organic matter, and the calcareous reaction. The soil properties that are most important with respect to soil blowing are (1) soil texture, (2) organic matter content, (3) effervescence due to carbonate reaction with HCl, (4) rock and pararock fragment content, and (5) minerology. Soil moisture and the presence of frozen soil also influence soil blowing.

(c) Estimates. Soils are placed into wind erodibility groups on the basis of the properties of the soil surface layer. Exhibit 618-16 lists the wind erodibility index assigned to the wind erodibility groups. The wind erodibility index values are assigned because the dry soil aggregates are very use dependent on crop management factors.

(d) Entries. Enter the wind erodibility group and wind erodibility index values for surface layer(s) only. The range of valid entries for wind erodibility group data is 1, 2, 3, 4, 4L, 5, 6, 7, and 8. The lowest valid entry for wind erodibility index data is 0, and the highest is 310. The index values should correspond exactly to their wind erodibility group.

Exhibit 618-1 Guides for Estimating Risk of Corrosion Potential for Uncoated Steel. 1/

Property	**Limits**		
	Low	**Moderate**	**High**
Drainage class and texture	Excessively drained, coarse textured or well drained, coarse to medium textured soils; or moderately well drained coarse textured, soils; or some- what poorly drained, coarse textured soils	Well drained, moderate y fine textured soils; or moderately well drained, medium textured soils; or somewhat poorly drained, moderately coarse textured soils; or very poorly drained soils with stable high water table	Well drained, fine textured or stratified soils; or moderately well drained, fine and moderately fine textured or stratified soils; or somewhat poorly drained, medium to fine textured or stratified soils; or poorly drained soils with fluctuating water table
Total acidity 2/(meq/100g)	<8	8-12	≥12
Resistivity at saturation(ohm/cm) 3/	≥5,000	2,000-5,000	<2,000
Conductivity of saturated extract(mmhos cm^{-1}) 4/	<0.3	0.3-0.8	≥0.8

1/ Based on data in the publication "Underground Corrosion," table 99, p. 167, Circular 579, U.S. Dept. of Commerce, National Bureau of Standards.
2/ Total acidity is roughly equal to extractable acidity (as determined by Soil Survey Laboratories Method 6Hla, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004).
3/ Roughly equivalent to resistivity of fine-and medium-textured soils measured at saturation (Method 8E1, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004). Resistivity at saturation for coarse-textured soil is generally lower than when obtained at field capacity and may cause the soil to be placed in a higher corrosion class.
4/ Method 8Ala, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004. The relationship between resistivity of a saturated soil paste (Method 8E1) and electrical conductivity of the saturation extract (Method 8A1a), is influenced by variations in the saturation percentage, salinity, and conductivity of the soil minerals. These two measurements generally correspond closely enough to place a soil in one corrosion class.

Exhibit 618-2 Guide for Estimating Risk of Corrosion Potential for Concrete.

Property	**Limits 1/**		
	Low	**Moderate**	**High**
Texture and reaction	Sandy and organic soils with pH>6.5 or medium and fine textured soils with pH>6.0	Sandy and organic soils with pH5.5-6.5 or medium and fine textured soils with pH 5.0 to 6.0	Sandy and organic soils with pH<5.5 or medium and fine textured soils with pH<5.0
Na and/or Mg sulfate (ppm)	Less than 1000	1000 to 7000	More than 7000
NaCl (ppm)	Less than 2000	2000 to 10000	More than 10000

1/ Based on data in National Handbook of Conservation Practices, Standard 606, Subsurface Drain, 1980.

Exhibit 618-3 Crop Names and Units of Measure.

(Refer to the data dictionary of the National Soil Information System for crop_names and crop_yield_units in http://nasis.nrcs.usda.gov/documents/metadata/5_3/n53clr.pdf.

Exhibit 618-4 Classification of Soils and Soil-Aggregate Mixtures for the AASHTO System.

General Classification	Granular Materials (35% of less passing No. 200)							Silt-Clay Materials (More than 35% passing No. 200)			
Group classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve analysis, % passing											
No. 10	50 max	-	-	-	-	-	-	-	-	-	-
No. 40	30 max	50 max	51 max	-	-	-	-	-	-	-	-
No 200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40											
Liquid limits	-		-	40 max	41 max	40 max	41 min	40 max	41 min	40max	41 min *
Plasticity index	6 max		NP	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General rating as subgrade	Excellent to good					Fair to good					

* Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plastaicity index of A-7-6 subgroup is greater than LL minus 30.

Exhibit 618-5 Potential Frost Action.

Soil moisture regime	**Frost action classes 1/, 2/**		
	Low	**Moderate**	**High 3/**
Aquic	Cindery, Fragmental, Pumiceous	Sandy, Sandy-skeletal	Coarse-loamy, Fine-loamy, Coarse-silty, Fine-silty, Loamy-skeletal, Clayey and clayey skeletal, Organic soil materials, Ashy, ashy-pumiceous, and ashy-skeletal, Medial, medial- pumiceous, and medial-skeletal, Hydrous- pumiceous, Hydrous-skeletal, Hydrous
Udic, Xeric, Ustic (when irrigated), Aridic (when irrigated)	Fragmental, Cindery, Sandy, Sandy-skeletal, Pumiceous	Coarse-loamy, Fine-loamy, Loamy-skeletal, Clayey, Clayey-skeletal, Ashy-pumiceous, Ashy-skeletal, Hydrous-skeletal, Medial-skeletal, Medial-pumiceous	Coarse-silty, Fine-silty, Ashy Medial, Hydrous- pumiceous, Hydrous
Ustic, Aridic	Fragmental, Sandy, Sandy-skeletal, Clayey, Clayey-skeletal, Cindery, Ashy, ashy-pumiceous, and ashy-skeletal, Medial and medial-skeletal, Pumiceous	Coarse-loamy, Fine-loamy, Coarse-silty, Fine-silty, Loamy-skeletal, Medial-pumiceous, Hydrous-pumiceous, Hydrous-skeletal, Hydrous	

1/ Taxonomic family particle-size classes apply to the whole soil to the depth of frost penetration, which is not necessrily the same as the taxonomic family particle-size control section.
2/ Isomesic and warmer temp regimes would have a "none" frost action class.
3/ Organic soil materials with a mesic or greater temperature regime and a udic moisture regime (e.g. Folists) have "high" frost action class.

Exhibit 618-6 Distribution of Design Freezing Index Values in the Continental United States.

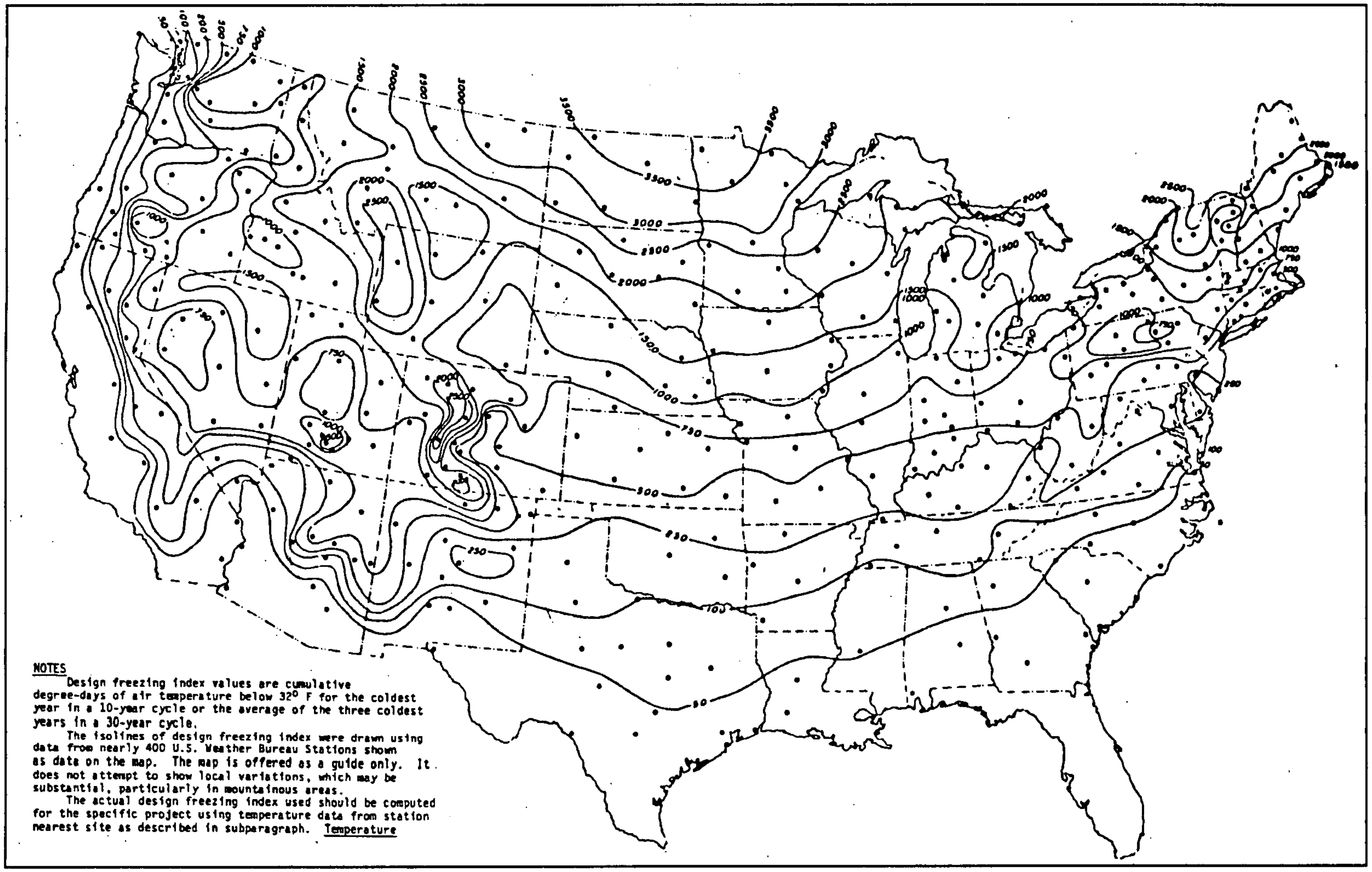


Exhibit 618-7 Estimating LL and PI from Percent and Type of Clay.

The following two formulas provide estimates of liquid limit and plasticity index. These calculations are included in the National Soil Information System and provide default values to LL and PI.

LL = 11.60 + [1.49 x 15 bar water %] + [1.35 x org. carbon %] + [0.6 x LEP]
+ [0.26 x non-carbonate clay %]*

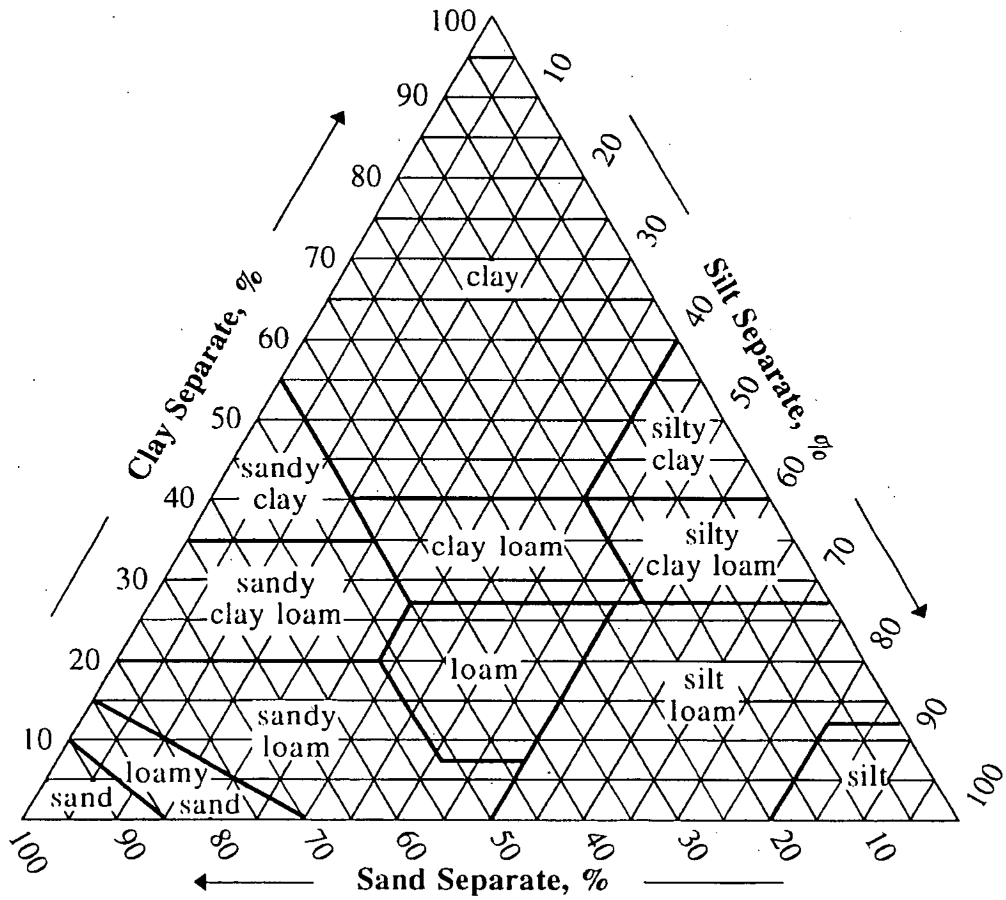
where LL is liquid limit
LEP is Linear Extensibility Percent

PI = -1.86 + [0.69 x 15 bar water %] - [1.19 x organic carbon %] +[0.13 x LEP]
+[0.47 x non-carbonate clay %]*

where PI is Plasticity Index
LEP is Linear Extensibility Percent

* When the calculated PI < 0.5, the PI is set to zero (nonplastic). When the calculated LL < 15 or PI < 0.5, the LL is set to zero.

Exhibit 618-8 Texture Triangle and Particle-Size Limits of AASHTO, USDA, and Unified Classification Systems.



COMPARISON OF PARTICLE SIZE SCALES

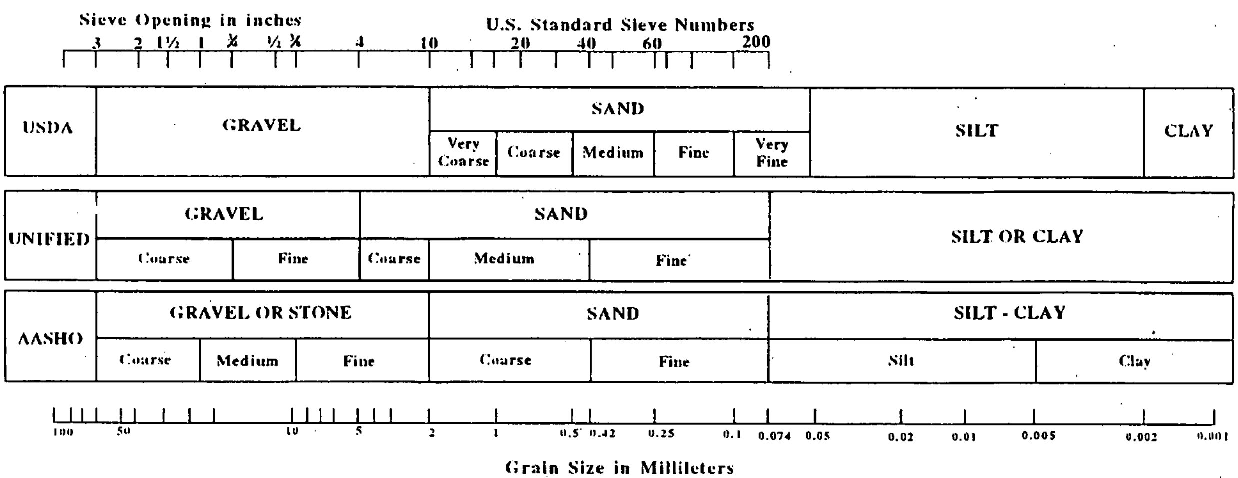
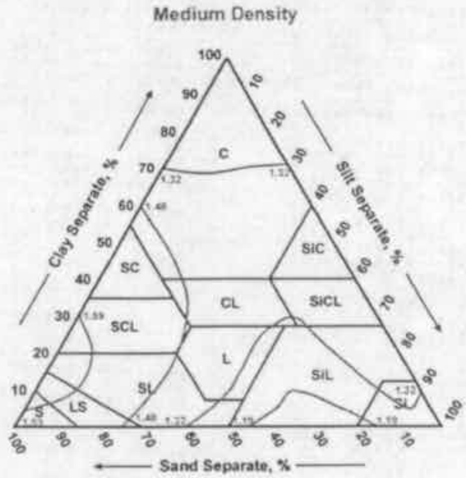
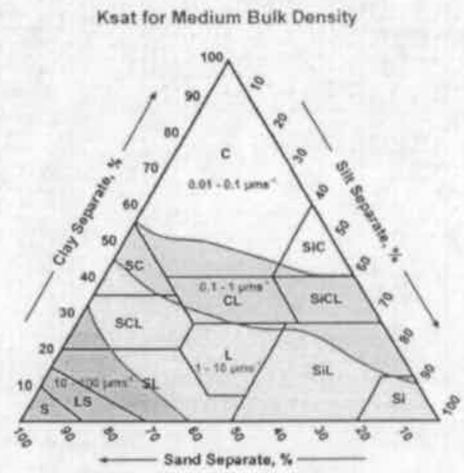
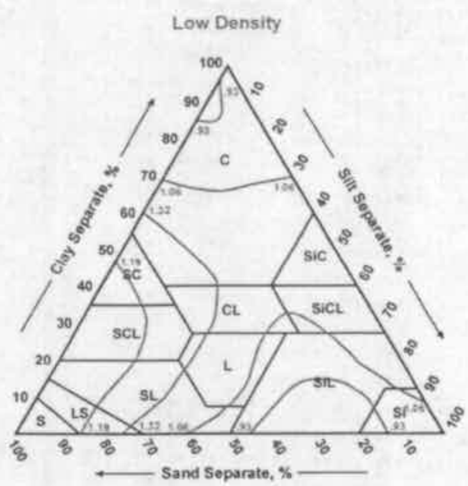


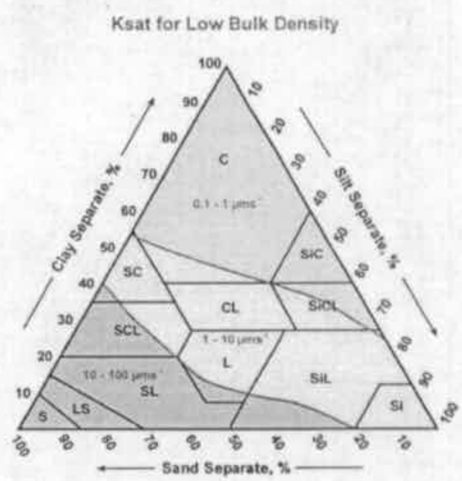
Exhibit 618-9 Guide for Estimating Ksat from Soil Properties.

Estimate saturated hydraulic conductivity (Ksat) from soil texture by first selecting the bulk density class of medium, low or high. Then use the corresponding textural triangle to select the range of saturated hydraulic conductivity in μms^{-1}. Overrides on next page.

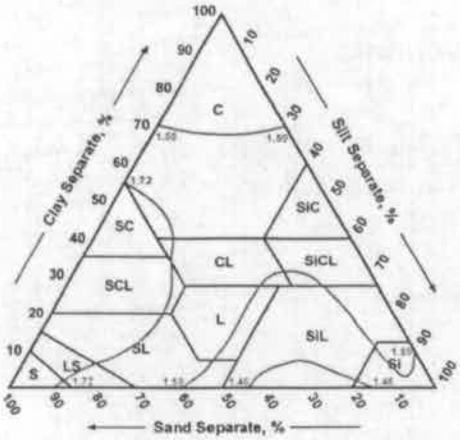








High Density



Ksat for High Bulk Density

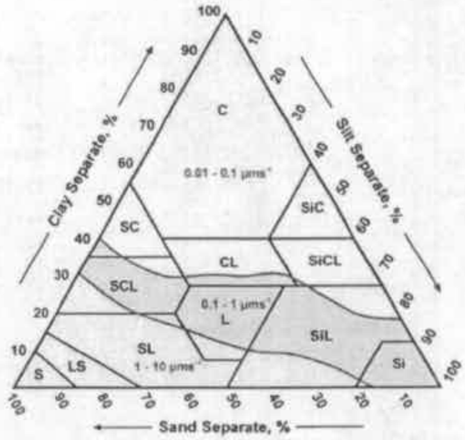


Exhibit 618-9 (continued)

Use these overrides in lieu of the textural guide above when these conditions exist. A single property statement is sufficient for an override from the textural guide.

Overriding condition	**Saturated hydraulic conductivity (μm s^{-1})**
All fragmental, cindery or pumiceous	≥ 100
Many medium or coarser vertical pores that extend through the layer.	≥ 100
Medial-pumiceous, medial-skeletal, ashy-pumiceous, ashy-skeletal, hydrous-pumiceous that is very friable, friable, soft, or loose.	10 – 100
When moderately moist or wetter, structure that is moderate or strong granular, strong blocky or prismatic smaller that is very coarse and no stress surfaces or slickensides.	10 – 100
Common medium or coarser vertical pores that extend through the layer.	10 – 100
Strong very coarse blocky or prismatic and no stress surfaces or slickensides.	1 – 10
≥ 35 percent clay, soft, slightly hard, very friable or friable, no stress surfaces or slickensides and the clay is subactive after subtracting the quantity (2 x (OC x 1.7))	1 – 10
Few stress surfaces and/or slickensides.	0.1 – 1
Massive and very firm or extremely firm, or weakly cemented.	0.1 – 1
Continuously moderately cemented.	0.1 – 1
Common or many stress surfaces and/or slickensides.	0.01 - 0.1
Continuously indurated or very strongly cemented.	< 0.01

Exhibit 618-10 Guide to Estimating Water Movement Through Lithic and Paralithic Materials. 1/ 2/

Material	Water Movement µm s^{-1}
Sandstone	
unfractured	<10
fractured	10-100
weathered	10-100
Limestone	
unfractured	<1
fractured	<10
weathered	<10
Limestone, Karst	>100
Shales and Mudstones	
consolidated	<1
weathered	<10
Igneous and Metamorphic Rocks	
unfractured	<1
fractured	1-100
weathered	<1

1/ This table is to be used as a guide and may be adjusted to reflect local, regional, or state bedrock permeability data. Fracturing may increase hydraulic conductivity of consolidated rock by a factor of 10^4 to 10^6, which is dependent on the degree and interconnection of fracturing. (Freeze and Cherry, 1979; Legget and Karrow, 1983).
2/ This table assumes that materials are level bedded. Tilted beds of some materials may have rapid rates of water movement that goes directly to an aquifer.
3/ Haan, C.T., Barfield, B.J., and Hayes, J.C.; Design Hydrology and Sedimentaology for Small Catchments.

Exhibit 618-11 Percent By Volume Conversion to Percent by Weight.

Chart for Estimating Rock Fragment Conversion & Textural Class Modifiers Related to Rock Fragments & Percent Passing No. 10 Sieve

Percent Passing No. 10 Sieve (Based on Dry Bulk Density of 1.5 g/cc); body of table: Percent Gravel - Volume

Col. 1 Vol.	Col. 2 Wt.	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	0	100	90	80	74	68	62	56	50	45	40	35	31	27	23	20	16	13	10	7	3	0
3	5			77	71	65	59	54	48	43	38	33	29	25	22	19	15	12	9	7	3	0
7	10			75	69	63	57	52	46	41	37	32	28	24	21	18	15	12	9	7	3	0
10	15			73	67	61	56	51	45	40	35	31	27	23	20	17	14	11	9	7	3	0
13	20			71	65	59	55	49	44	39	34	30	26	23	20	17	14	11	9	7	2	0
16	25			69	63	57	52	47	42	38	33	29	25	22	19	16	13	10	8	6		
20	30			66	60	55	50	45	40	36	32	28	24	21	18	15	12	10	8	6		
23	35			64	58	53	48	43	38	34	30	26	23	20	17	14	11	9	8	6		
27	40			61	56	51	46	41	37	33	29	25	22	19	16	13	11	9	7	6		
31	45			59	54	49	44	39	35	31	27	24	21	18	15	12	10	8	6	5		
35	50			55	50	46	42	38	34	30	26	23	20	17	15	12	10	8	6	5		
40	55			49	45	42	38	35	32	29	25	22	19	16	14	11	9	7	6	5		
45	60			45	42	39	35	33	30	27	24	21	18	15	13	11	9	7	6	5		
50	65			41	38	35	33	30	28	25	22	20	17	15	13	10	8	7	6	5		
56	70			38	35	33	30	28	25	23	21	19	16	14	12	10	8	7	6	5		
62	75			34	32	30	28	26	24	22	19	17	15	14	12	9	7	6	5	4		
68	80			30	27	25	23	21	19	17	16	15	14	13	11	9	7	6	5	4		
74	85			25	23	21	18	16	14	12	11	10	9	8	7	6	6	5	5	4		
80	90			18	17	16	14	13	11	10	9	8	7	6	6	5	5	4	4	3		

Percent Rock Fragments > 3" (Form 5)

Chart region labels: Gravelly; Cobbly or Stony; lines A, B, C, D, E.

Texture Class Modifiers

- Non Gravelly, Cobbly or Stony (<15% Vol.) — A
- Gravelly, Cobbly or Stony (15 To 35% Vol.) — B
- Very Gravelly Cobbly, or Stony (35 To 60% Vol.) — C
- Extremely Gravelly, Cobbly or Stony (> 60% Vol.)

Chart for Estimating Rock Fragments and Textural Class Modifier

Exhibit 618-11 Percent By Volume Conversion to Percent by Weight. (continued)

Instructions--This chart can be used to:
1. Estimate the percent gravel by volume from estimates of percent of rock fragments passing the No. 10 sieve and percent larger than 3 inches.
2. Convert weight to volume or volume to weight for fragments (columns 1 and 2), based on dry bulk density 1.5 g cm^{-3}.
3. Check or determine the texture modifier that coincides with percent passing No. 10 sieve and percent larger than 3 inches.
(a) less than 15 percent fragments-nongravelly, noncobbly, or nonstony
(b) 15 to less than 35 percent fragments - gravelly, cobbly, or stony
(c) 35 to less than 60 percent fragments - very gravelly, very cobbly, or very stony, and
(d) 60 to less than 90 percent fragments - extremely gravelly, extremely cobbly, or extremely stony.
(e) 90 or more percent fragments – gravel, cobbles, stones, or boulders.
4. Estimate percent passing No. 10 sieve (weight) for various combinations of rock fragment percentages by volume (top).
The A line separates the nongravelly, noncobbly, or nonstony soils from the gravelly, cobbly, or stony soils (15 percent fragments by volume).
The B line separates the gravelly, cobbly, or stony soils from the very gravelly, very cobbly, or very stony soils (35 percent fragments by volume).
The C line separates the very gravelly, very cobbly, or very stony soils from the extremely gravelly, extremely cobbly, or extremely stony soils (60 percent fragments).
The D line shows the break between gravelly size and cobbly size texture modifiers--2.0 times or more as much gravel as cobble to use gravelly if more than 35 percent fragments, and 1.5 times or more as much gravel as cobble to use gravelly if 15 to 35 percent fragments.
The E line shows the break between gravelly size and stony size texture modifiers--2.5 times or more as much gravel as stone to use gravelly if more than 35 percent fragments, and 2.0 times or more as much gravel as stone to use gravelly if 15 to 35 percent fragments.

TEXTURE MODIFIER GUIDE [i] Substitute channers for gravel, flagstones for cobbles, etc. where applicable

Total Rock Fragments (%)	GR + CB > GR + ST	MODIFIER		GR + CB ≤ GR + ST
≥ 15 < 35	GR:CB ≥ 1.5	Gravelly	Gravelly	GR:ST ≥ 2
	GR:CB < 1.5	Cobbly	Stony	GR:ST < 2
≥ 35 < 60	GR:CB ≥ 2	Very Gravelly	Very Gravelly	GR:ST ≥ 2.5
	GR:CB < 2	Very Cobbly	Very Stony	GR:ST < 2.5
≥ 60 < 90	GR:CB ≥ 2	Extremely Gravelly	Extremely Gravelly	GR:ST ≥ 2.5
	GR:CB < 2	Extremely Cobbly	Extremely Stony	GR:ST < 2.5

[i] Substitute channers for gravel, flagstones for cobbles, etc. where applicable.

All conversion of fragments from volume to weight and percent passing No. 10 sieve are based on dry bulk density of 1.5 g cm^{-3}. If desired, adjustments can be made in estimates by adding to subtracting 3 percent for each 0.2 g cm^{-3} change in bulk density. Add for lower bulk density; subtract for higher bulk density.

EXAMPLE A

Step 1: If 20 percent by weight is composed of cobble and stone (fragments greater than 3 inches, col. 2) and 40 percent passing No. 10 sieve, where the columns intersect shows 39 percent is gravel by volume.
Step 2: The 20 percent cobble and stone by weight (col. 2) equals 13 percent cobble and stone by volume (col. 1). And 13 percent cobble and stone (vol.) + 39 percent gravel (vol.) (step 1) equals 52 percent fragments by volume.
Step 3: The intersection of 13 percent cobble and stone and 39 percent gravel by volume is above the D line, and occurs in the blue area (35 to 60 percent fragment by volume), so the texture modifier is very gravelly.

EXAMPLE B

If field estimates for fragments show 10 percent cobble and stone and 30 percent gravel (vol.), enter the chart from 10 percent col. 1 (15 percent col. 2) go horizontally to 31 (closest to 30 percent gravel) and then vertically to estimate that 50 percent passes No. 10 sieve. This soil is very gravelly because it is in the blue and above lines D and E.

EXAMPLE C

If the soils is designated as very gravelly then it should fall within the blue color and above line D, it should show that 0 to 55 percent passes a No. 10 sieve, and it should show that 0 to 30 percent or less by weight is larger than 3 inches.

Exhibit 618-12 Soil Erodibility Nomograph.

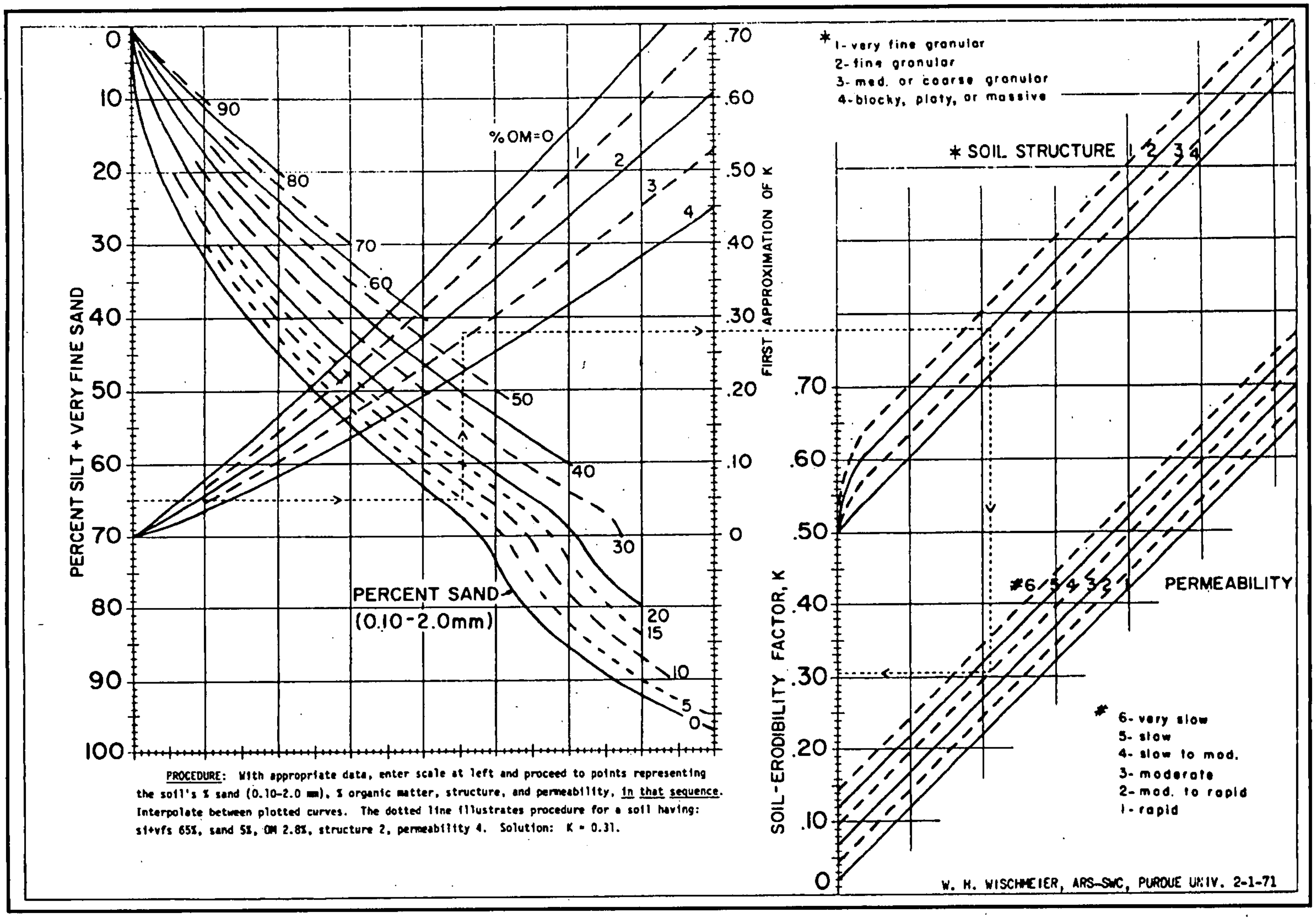


Exhibit 618-13 Kw Value Associated with Various Fragment Contents.

Fragment vol. %	Mulch factor 1/	Kf value classes of less than 2 mm soil fraction										
		.10	.15	.20	.24	.28	32	37	.43	.49	.55	64
5	.90	.09	.14	.18	.22	.25	.29	.33	.39	.44	.50	.58
10	.77	.08	.12	.15	.18	.22	.25	.28	.33	.38	.42	.49
15	.68	.07	.10	.14	.16	.19	.22	.25	.29	.33	.37	.43
20	.61	.06	.09	.12	.15	.17	.20	.23	.26	.30	.37	.39
25	.54	.05	.08	.11	.13	.15	.17	.20	.23	.26	.30	.35
30	.48	.05	.07	.10	.12	.13	.15	.18	.21	.24	.26	.31
35	.43	.04	.06	.09	.10	.12	.14	.16	18	.21	.24	.28
40	.38	.04	.06	.08	.09	.11	.12	.14	.16	.19	.21	.24
45	.34	.03	.05	.07	.08	.10	.11	.13	.15	.17	.19	.22
50	.30	.03	.05	.06	.07	.08	.10	.11	.13	.15	.17	.19
55	26	.03	.04	.05	.06	.07	.08	.09	.11	.13	.12	.14
60	.22	.02	.03	.04	.05	.06	.07	.08	.09	.11	.12	.14
65	.19	.02	.03	.04	.05	.05	.06	.07	.08	.09	.10	.12
70	.16	.02	.02	.03	.04	.04	.05	.06	.07	.08	.09	.10
75	.13	.01	.02	.03	.04	.04	.04	.04	.06	.06	.07	.08
80	.10	.01	.02	.02	.02	.03	.03	.04	.04	.05	.06	.06
85	.08	.01	.02	.02	.02	.02	.03	.03	.03	.04	.04	.05
90	.06	.01	.01	.01	.01	.02	.02	.02	.03	.03	.03	.04
95	.04	.01	.01	.01	.01	.01	.01	.02	.02	.02	.02	.03
100	.03	.01	.01	.01	.01	.01	.01	.01	.01	.02	.02	.02

1/ Mulch factor is the ratio of the soil loss from soils with the specified fragment volumes to that from soils with no fragments. The table was constructed from the zero canopy curve, figure 6, page 19 in AH 537 (USDA-SEA 1978).

Exhibit 618-14 General Guidelines for Assigning Soil Loss Tolerance "T".

Soil loss tolerance "T" is assigned according to properties of root limiting subsurface soil layers. The designation of a limiting layer implies that the material above the layer has more favorable plant growth properties. As limiting or less favorable soil layers become closer to the surface, the relative ability of a soil to maintain its productivity through natural and managed processes decreases.

Criteria for assigning "T" are estimated from:

1. The severity of physical or chemical properties of subsurface layers.

2. The climatically influenced properties of soil moisture and temperature.

3. The economic feasibility of utilizing management practices to overcome limiting layers or conditions.

The following general guide was used with specific soil properties and conditions to write criteria statements for programming "T" factors at Iowa State University Statistical Laboratory.

Depth to limiting layer	Group 1	Group 2	Group 3
(inches)	Annual soil loss tolerance in tons/acre		
0 - 10	1	1*	3
10 - 20	1	2	3
20 - 40	2	3	4
40 - 60	3	4	4
>60	5	5	5

Group 1--The limitations are significant or have permanent layers of root limitation.
Group 2--The limitations are of moderate root restriction, or have a less than permanent loss to productivity in a given climate.
Group 3--The limitations can be overcome in a given climate, through natural or managed processes to achieve the productivity level of the non-eroded soil.

*Some soils are assigned with soil loss tolerance of 2.

Exhibit 618-14 "T" Criteria (continued).

"T" CRITERIA
3/11/1995

Soil Characteristic		Definition	Depth Limit (inches)	T Value
1. Bedrock	A.	Soils in all Land Resource Regions except W, X, and Y having SOFT identified in the Bedrock soil property block or MARL (marl layers) with the beginning depth of:	<10 10-20 20-40 40-60 >60	1 2 3 4 5
		OR		
	B.	Soils having HARD identified in the Bedrock soil property block or layers identified as ICE with the beginning depth of:	<20 20-40 40-50 >60	1 2 3 5
		OR		
	C.	Soils in only Land Resource Regions W, X, and Y having SOFT identified in the Bedrock soil property block or MARL (marl layers) with the beginning depth of:	<20 20-40 40-60 >60	1 2 3 5
2. Cemented pans [1]				
	A.	Soils in all Land Resource Regions except W, X, and Y having duripan, petrocalcic, petrogypsic, petroferric with THIN in Cemented Pan block and CEM in lieu of texture OR THIN or THICK if IND or CEM are not shown in lieu of texture with the beginning depth of:	<20 20-40 40-60 >60	2 3 4 5
		OR		
	B.	Soils in all Land Resource Regions except W, X, and Y having duripan, petrocalcic, petrogypsic, petroferric with THICK in Cemented Pan block and CEM and/or IND in lieu of texture or THIN in Cemented Pan Block and IND in lieu of texture with the beginning depth of:	<20 20-40 40-60 <60	1 2 3 5
	C.	Soils in only Land Resource Regions W, X, and Y having duripan, petrocalcic, petrogypsic, petroferric with THIN in Cemented Pan block and CEM in lieu of texture OR THIN or THICK if IND or CEM are not shown in lieu of texture with the beginning depth of:	<20 20-40 40-60 >60	1 2 3 5
3. Fragmental/Cindery				
	A.	Soils in all Land Resource Regions except W, X, and Y having an upper layer that has a texture term other than SG, G, FRAG, or CIND immediately above a layer of G, FRAG or CIND beginning at depth of:	<10 10-20 20-40 40-60 >60	1 2 3 4 5
B. Soils in Land Resource		Regions W, X, and Y having an upper layer that has a texture term other than SG, G, FRAG, or CIND immediately above a layer of G, FRAG or CIND beginning at depth of:	<20 20-40 40-60 >60	1 2 3 5

[1] Where cemented pan is effectively ripped causing an increase in rooting depth, assign T according to new depth to restrictive material, if present (e.g., any restrictive underlying material).

4. Fragipan		Soils having a FRAGI great group. Layer selected has the greatest bulk density inflection, (layer selected has the maximum change which was determined by evaluating all adjacent layers that change from a lower bulk density to a higher bulk density) and a permeability less than or equal to 0.2 inches per hour, beginning at a depth of:	<20 20-60 >60	3 4 5
5. Natric	A.	Soils designated in great groups of Natraquolls or Natraqualfs or subgroups of Natric Duraquolls but exclude subgroups of Glossic in the great group of Natraqualfs; and have a natric horizon (to find the natric horizon: search for a subsoil, subsurface, layer with the slowest permeability [<0.2 inches/hour] above a layer, if present, with UWB, WB, CEM, or IND and use the upper depth of that layer to assign depth to natric horizon) beginning at a depth of:	<20 20-40 40-60 >60	2 3 4 5
	B.	Use criterion B in MLRA's 48A, 48B, 49, 52, 53A, 53B, 53C, 54, 55A, 55B, 55C, 56, 58A, 58B, 58C, 58D, 60A, 60B, 61, 62, 63A, 63B, 64 through 79, 80A, 80B, 81, 82, 83A, 83B, 83C, 83D, 84A, 84B, 84C, 85, 86, 87, 102A, and 102B. Soils designated in great groups of Natralbolls, Natriborolls, Natrustolls, *Natriboralfs, Natrustalfs Natrargids, Nadurargids, or subgroups of Natric Durustolls but exclude subgroups of Glossic in great groups of Natriborolls, Natrustolls, Natriboralfs, Natrustalfs, and Natrargids; and have a natric horizon (to find the natric horizon: search for a subsoil, subsurface, layer with the slowest permeability (<0.2 inches/hour] above a layer, if present, with UWB, WB, CEM, or IND and use the upper depth of that layer to assign depth to natric horizon) beginning at a depth of: *At present, Natriboralfs are rare in the United States, and subgroups have not been developed.	<20 20-40 40-60 >60	2 3 4 5
	C.	Soil designated in great group with "NA" and suborder "UD" and a subsurface natric horizon with a slow or very slow permeability (to find the natric horizon: search for a subsoil, subsurface, layer with the slowest permeability [<0.2 inches/hour] and use the upper depth of that layer to assign depth to natric horizon) beginning at a depth of:	<20 20-60 >60	3 4 5
	D.	Soils in Land Resource Regions A, B, C, D, and E except MRLA's 48A, 48B, and 49 having a subsurface natric horizon with equal to or greater than 35 percent clay; slow or very slow permeability (to find the natric horizon: search for a subsoil, subsurface, layer with the slowest permeability [<0.2 inches/hour and equal to or more than 35 percent clay] and use the upper depth of that layer to assign depth to natric horizon); and with aridic or xeric soil moisture regime and in great groups designated as Nadurargids, Natrixerolls, Natrargids, or Natrixeralfs or subgroups of Natric Durixeralfs or Aridic Natrixerolls with the slow or very slow permeability beginning at a depth of:	<20 20-40 40-60 >60	2 3 4 5

6. Sandy or Sandy Skeletal Substratum	A. Soils in all Land Resource Regions except A, B, C, D, E, W, X , and Y and MLRA's 52, 58A, 60B, 101, 140 141,142, 143, 144A, 144B 145, and 146 having sandy substratum layer(s) of SG, COS, S, LS, FS, or LCOS (with or without rock fragment modifiers); or SR with these textures; that extend to a depth of 60 inches or more; with a permeability equal to or greater than 6 inches per hour (A) immediately below a layer or layers that have (1) a permeability of less than 6 inches per hour, (2) less than 50 percent fine or coarser sand separates in the fine earth fraction, and (3) a combined thickness of equal to or more than 10 inches; OR (B) immediately below a layer or layers that have (1) CE, DE, FB, HM, MPT, MUCK, PEAT, or SP in lieu of texture, and (2) a combined thickness of equal to or more than 10 inches. With a substratum beginning at a depth of:	10-20 20-60 >60	3 4 5
	OR		
	B. Soils in Land Resource Regions A, B, C, D, and E and MLRA's 52, 58A, 60B, 101, 140, 141, 142,143, 144A, 144B 145, and 146 having sandy substratum layer(s) of SG, COS, S, LS, FS, or LCOS (with or without rock fragment modifiers); or SR with these textures; that extend to a depth of 60 inches or more; with a permeability equal to or greater than 6 inches per hour (A) immediately below a layer or layers that have (1) a permeability of less than 6 inches per hour, (2) less than 50 percent fine or coarser sand separates in the fine earth fraction, and (3) a combined thickness of equal to or more than 10 inches; OR (B) immediately below a layer or layers that have (1) CE, DE, FB, HM, MPT, MUCK, PEAT, or SP in lieu of texture, and (2) a combined thickness of equal to or more than 10 inches. With a substratum beginning at a depth of:	10-20 20-40 40-60 >60	2 3 4 5
	OR		
	C. Soils in Land Resource Regions W, X, and Y having sandy substratum layer(s) of SG, COS, S, LS, FS, or LCOS (with or without rock fragment modifiers); or SR with these textures; that extend to a depth of 60 inches or more; with a permeability equal to or greater than 6 inches per hour (A) immediately below a layer or layers that have (1) a permeability of less than 6 inches per hour, (2) less than 50 percent fine or coarser sand separates in the fine earth fraction; and (3) a combined thickness of equal to or more than 10 inches; OR (B) immediately below a layer or layers that have (1) CE, DE, FB, HM, MPT, MUCK, PEAT, or SP in lieu of texture, and (2) a combined thickness of equal to or more than 10 inches. With a substratum beginning at a depth of:	10-20 20-40 40-60 >60	1 2 3 5
7. Abrupt Textural Change	A. Soils in orders of Alfisols, Aridisols, Mollisols, or Ultisols and (1) all Pale great groups of those orders, Albaqualfs or Argialbolls; or (2) soils in xer, bor, alb, arg, aqu, or argi suborders with great groups of alb, argi, eutro, dur, or cry with subgroups of Abruptic, Abruptic Aridic,	<20 20-60 >60	3 4 5

Abruptic Cryic or Abruptic Xerollic; or

(3) Alfic Haploxerands or Alfic Vitrixerands with an argillic horizon with equal to or greater than 35 percent clay; AND having an adjacent upper layer with a permeability of more than 0.6 inches/hour overlying and adjacent to a lower layer having more than 35 percent clay with a permeability of less than 0.2 inches/hour

OR

having an adjacent upper layer with permeability greater than 0.2 inches per hour overlying and adjacent to a lower layer having equal to or more than 35 percent clay with a permeability of less than 0.06 inches per hour beginning at a depth of:

Criteria A. will be used in the following MLRA's 1, 2, 3, 4, 5, 6, 8 through 10, 10A, 11, 11A, 11B, 12 through 15, 17 through 27, 28A, 28B, 29 through 32, 34, 35, 37, 39, 40, 41, 43, 44, 47, 48A, 48B, 52, 53A, 54, 58A, 58B, 60A, 60B, and 67.

B. Soils in orders of Alfisols, Mollisols, or Ultisols and; (1) Albaqualfs with subgroups of Udollic, Aeric, Mollic, or Typic; or (2) Hapludalfs with subgroups of Albaquultic or Albaquic; or (3) Typic Argialbolls; (4) Abruptic Argiaquolls; or (5) Albaquults with subgroups of Typic or Aeric with an argillic horizon with equal to or more than 35 percent clay; AND having an adjacent upper layer with a permeability of more than 0.6 inches/hour overlying and adjacent to a lower layer having more than 35 percent clay with a permeability of less than 0.2 inches/hour

<20	3
20-60	4
>60	5

OR

having an adjacent upper layer with permeability greater than 0.2 inches per hour overlying and adjacent to a lower layer having equal to or more than 35 percent clay with a permeability of less than 0.06 inches per hour beginning at a depth of:

Criteria B. will be used in the following MRLA's: 71, 73, 74, 75, 76, 102B, 106, 107, 108, 109, 111, 112, 113, 114, and 115.

C. Soils in orders of Alfisols and Mollisols with an argillic horizon with equal to or more than 35 percent clay: AND having an adjacent upper layer with permeability greater than 0.6 inches per hour overlying and adjacent to a lower having equal to or more than 35 percent clay with a permeability of less than 0.2 inches per hour;

<20	3
20-60	4
>60	5

OR

having an adjacent upper layer with permeability greater than 0.2 inches per hour overlying and adjacent to a lower layer having equal to or more than 35 percent clay with a permeability of less than 0.06 inches per hour beginning at a depth of:

Criteria C. will be used in the following MLRA's 108, 109, 110, 113, 114, 115, 115A, 115B, and 115C.

8. Dense Layer

A. Soils having a layer whose upper boundary begins at the depths indicated and has the following average bulk density for layer soil textural class(s); and with permeability difference of 2 classes between dense layer and upper adjacent layer.

(excluding Vertisols, and Vertic subgroups)
(not used in Land Resource Regions R, W, X,
and Y and MLRA's 100 and 101):

Layer Soil Textural Class [1]	Moist Avg.BD	Layer Depth	T Value
COS, S, LCOS, LS, FS, LFS	>1.80	<20	3
		20-60	4
		>60	5
VFS, LVFS, FSL, COSL VFSL, SL, with average <18 percent clay.	>1.75	<20	3
		20-60	4
		>60	5
COSL, VFSL, FSL, SL, or CL and average 18 to 35 percent clay or L or SCL	>1.7	<20	3
		20-60	4
		>60	5
SI, SIL, or SICL and average <35 percent clay.	>1.6	<20	3
		20-60	4
		>60	5
CL, SC, C, SICL, SIC and clay average within 35 to 60 percent clay.	>1.55	<20	3
		20-60	4
		>60	5
C with average clay value 60 percent or more clay (exclude Soil Orders of Andisols and Oxisols).	>1.35	<20	3
		20-60	4
		>60	5

OR

B. Soils in Land Resource Regions W, X, and Y for soils having a layer whose upper boundary begins at the depths indicated and has the following average bulk density for layer soil textural class(s); and with permeability difference of 2 classes between dense layer and upper adjacent layer. (excluding Vertisols, and Vertic subgroups):

Layer Soil Textural Class[2]	Moist Avg.BD	Layer Depth	T Value
COS, S, LCOS, LS, FS, LFS	>1.80	<20	1
		20-40	2
		40-60	3
		>60	5
VFS, LVFS, FSL, COSL, VFSL, or SL with average <18 percent clay.	>1.75	<20	1
		20-40	2
		40-60	3
		>60	5
COSL, VFSL, FSL, SL, or CL and average 18 to 35 percent clay or L or SCL	>1.7	<20	1
		20-40	2
		40-60	3
		>60	5
SI, SIL, or SICL and average <35 percent clay.	>1.6	<20	1
		20-40	2
		40-60	3
		>60	5
CL, SC, C, SICL, SIC and average within 35 to 50 percent clay.	>1.55	<20	1
		20-40	2
		40-60	3
		>60	5
C with average clay value 60 percent or more clay (exclude Soil Orders of Andisols and Oxisols).	>1.35	<20	1
		20-40	2
		40-60	3
		>60	5

C. Soils in Land Resource Region R and MLRA's 100 and 101 having a layer whose upper boundary begins at the depths indicated and has the following average bulk density for layer soil textural class(es):

Layer Soil Textural Class [1]	Moist Avg.BD	Layer Depth	T Value
COS, S, LCOS, LS, FS, LFS	>1.75	<20	2
		20-40	3
		40-60	4
		>60	5
VFS, LVFS, FSL, COSL VFSL, or SL with average <18 percent clay.	>1.75	<20	2
		20-40	3
		40-60	4
		>60	5
COSL, VFSL, FSL, SL, or CL and average 18 to	>1.7	<20	2
		20-40	3

[2] Layer soil textural class - excludes the surface layer.

		35 percent clay or L or SCL		40-60	4
				>60	5
		SI, SIL, or SICL and average <35 percent clay.	>1.6	<20	2
				20-40	3
				40-60	4
				>60	5
		CL, SC, C, SICL, SIC and average 35 to 60 percent clay.	>1.55	<20	2
				20-40	3
				40-60	4
				>60	5
		C with average 50 percent or more clay	>1.35	<20	2
				20-40	3
				40-60	4
				>60	5
		D. Soils in Land Resource Regions W, X, and Y that have a combined surface layer of 10 inches or more thick with a bulk density less than 1.10 and 95percent or more material passing the #10 sieve overlying a layer with soil textural modifiers of CB, CBV, CBX, ST, STV, or STX or less than 85 percent passing the #10 sieve:		<20	1
				20-40	2
				40-60	3
				>60	5
9.	Rock Fragments	If state equals CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT VA, and WV, use only the 2mm - 10 inch rock fragment fraction for the surface layer.			
		A. Soils in all Land Resource Regions except W, X, and Y having layer(s) with a combined thickness of equal to or more than 10 inches with (1) Texture with no rock fragment modifier, or (2) texture modified by BY, CB, GR, ST, CN, OR FL (in the Northeast states, this layer has 0 to 50 percent rock fragments by weight; texture modifiers are not used.), or (3) CE, DE, FB, HM, MPT, MUCK, PEAT, SP, VAR over a layer that extends to a depth of 60 inches or more that has a texture (exclude SG, COS, S, LS, FS, or LCOS) modified by BYX, CBX, GRX, STX, CNX, or FLX or over bedrock, CEM, or IND if texture modified by BYX, CBX, GRX, STX, CNX, or FLX extends to less than 50 inches, beginning at a depth of:		<20	3
				20-60	4
				>60	5
		OR			
		B. Soils in Land Resource Regions W, X, and Y having layer(s) with a combined thickness of equal to or more than 10 inches with (1) Texture with no rock fragment modifier, or (2) texture modified by BY, CB, GR, ST, CN, OR FL (in the Northeast states, this layer has 0 to 50 percent rock fragments by weight; texture modifiers are not used.), or (3) CE, DE, FB, HM, MPT, MUCK, PEAT, SP, VAR over a layer that extends to a depth of 60 inches or more that has a texture (exclude COS, S, SG, LS, FS, or LCOS) modified by BYX, CBX, GRX, STX, CNX, or FLX or over bedrock, CEM, or IND if texture modified by BYX, CBX, GRX, STX, CNX, or FLX extends to less than 60 inches, beginning at a depth of:		<20	1
				20-40	2
				40-60	3
				>60	5
		C. Soils in all Land Resource Regions except W, X, and Y having layer(s) with a combined thickness of equal to or more than 10 inches with (1) Texture with no rock fragment modifier, over a layer that extends to a depth of 60 inches or more that has a texture (exclude SG, COS, S, LS, FS, or LCOS) modified by BYV, CBV, GRV, STV, CNV, or FLV or		<20	3
				20-60	4
				>60	5

			over bedrock, CEM, or IND if texture modified by BYV, CBV, GRV, STV, CNV, or FLV extends to less than 60 inches, beginning at a depth of:		
			OR		
		D.	Soils in Land Resource Regions W, X, and Y having layer(s) with a combined thickness of equal to or more than 10 inches with (1) Texture with no rock fragment modifier over a layer that extends to a depth of 60 inches or more that has a texture (exclude COS, S, SG, LS, FS, or LCOS) modified by BYV, CBV, GRV, STV, CNV, or FLV or over bedrock, CEM, or IND if texture modified by BYV, CBV, GRV, STV, CNV/ or FLV extends to less than 60 inches, beginning at a depth of:	<20 20-40 40-60 >60	1 2 3 5
10.	High gypsum		Soils having a gypsiferous material layer designated as GYP at a beginning depth of:	<20 20-40 40-60 >60	2 3 4 5
11.	Organic	A.	Soils (excludes Land Resource Regions W, X, and Y) that are Histosols having organic soil material; and not lithic or limnic or terric or hydric subgroup (e.g., Terric, Hemic Terric, etc.), then "T" is		3
			OR		
		B.	Soils that are Histosols having a lithic, hydric, or limnic subgroup, then "T" is		1
			OR		
		C.	Soils that are Histosols having a terric subgroup (e.g., Terric, Hemic Terric, etc.), then "T" is		2
			OR		
		D.	Soils in Land Resource Regions W, X, and Y that are Histosols having organic soil material; and not lithic or limnic or terric or hydric subgroup (e.g., Terric, Hemic Terric, etc.), then "T" is		5
12.	High Carbonates		Criteria will be used after October 1, 1994. States will need to review and possibly need to update soil properties to generate appropriate "T" value using Criteria A and B.		
		A.	Soils in Land Resource Regions B, C, D, E, W, X, and Y having a surface layer with equal to or less than 15 percent calcium carbonate (CaC03) equivalent and have a subsurface layer with more than 25 percent (average) CaC03 equivalent OR having a surface layer with more than 15 percent calcium carbonate (CaC03) equivalent and a subsurface layer that exceeds the surface layer in calcium carbonate (CaC03) equivalent by 20 percent or more beginning at a depth of:	<20 20-40 40-60 >60	2 3 4 5
		B.	Soils (excludes Land Resource Regions B, C, D, E, W, X, and Y) having a surface layer with equal to less than 15 percent calcium carbonate (CaC03) equivalent and have a subsurface layer with more than 25 percent (average) CaC03 equivalent OR having a surface layer with more than 15 percent calcium carbonate (CaC03) equivalent and a subsurface layer that exceeds the surface layer in calcium carbonate (CaC03) equivalent by 20 percent or more beginning at a depth of:	<20 20-60 >60	3 4 5
13.	Severely		Soils designated on the		

Eroded	Soil Interpretations Record (SIR) as having a severely eroded unit modifier or have severely eroded shown in Class Determining Phase in Capability and Yields Per Acre of Crops and Pasture and have reduced productivity. These SIR's manually are adjusted 1 class of "T" value lower than the non-eroded SIR or Class Determining Phase.

Exhibit 618-15 Texture Class, Texture Modifiers, and Terms Used in Lieu of Texture.

Texture Modifiers**	
ART	Artifactual
ARTV	Very artifactual
ARTX	Extremely artifactual
ASHY	Ashy
BY	Bouldery
BYV	Very bouldery
BYX	Extremely bouldery
CB	Cobbly
CBV	Very cobbly
CBX	Extremely cobbly
CEM	Cemented
CN	Channery
CNV	Very channery
CNX	Extremely channery
COP	Coprogenous
DIA	Diatomaceous
FL	Flaggy
FLV	Very flaggy
FLX	Extremely flaggy
GR	Gravelly
GRC	Coarse gravelly
GRF	Fine gravelly
GRM	Medium gravelly
GRV	Very gravelly
GRX	Extremely gravelly
GS	Grassy
GYP	Gypsiferous
HB	Herbaceous
HYDR	Hydrous
MEDL	Medial
MK	Mucky
MR	Marly
MS	Mossy
ORH	Highly organic
PBY	Parabouldery
PBYV	Very Parabouldery
PBYX	Extremely Parabouldery
PCB	Paracobbly
PCBV	Very Paracobbly
PCBX	Extremely Paracobbly
PCN	Parachannery
PCNV	Very Parachannery
PCNX	Extremely Parachannery
PF	Permanently frozen
PFL	Paraflaggy
PFLV	Very Paraflaggy
PFLX	Extremely Paraflaggy
PGR	Paragravelly
PGRV	Very Paragravelly
PGRX	Extremely Paragravelly
PST	Parastony
PSTV	Very Parastony

Texture Class	
C	Clay
CL	Clay loam
COS	Coarse sand
COSL	Coarse sandy loam
FS	Fine sand
FSL	Fine sandy loam
L	Loam
LCOS	Loamy coarse sand
LFS	Loamy fine sand
LS	Loamy sand
LVFS	Loamy very fine sand
S	Sand
SC	Sandy clay
SCL	Sandy clay loam
SI	Silt
SIC	Silty clay
SICL	Silty clay loam
SIL	Silt loam
SL	Sandy loam
VFS	Very fine sand
VFSL	Very fine sandy loam

Terms used in lieu of texture	
AM	Artifactual material
BR	Bedrock
BY	Boulders
CB	Cobbles
CN	Channers
FL	Flagstones
G	Gravel
HPM	Highly decomposed plant material
MAT	Material
MPM	Moderately decomposed plant material
MPT	Mucky peat
MUCK	Muck
PBY	Paraboulders
PCB	Paracobbles
PCN	Parachanners
PEAT	Peat
PFL	Paraflagstones
PG	Paragravel
PST	Parastones
SPM	Slightly decomposed plant material
ST	Stones
W	Water

** "Texture Modifiers" may apply to both "texture class" and "terms used in lieu of texture". Some apply to both, others only apply to one or the other. Refer to part 618.67.

PSTX	Extremely Parastony
PT	Peaty
ST	Stony
STV	Very stony
STX	Extremely stony
WD	Woody

Exhibit 618-16 Wind Erodibility Groups (WEG) and Index.

WEG [1,3,4,5,7]	Properties of Soil Surface Layer	Dry Soil Aggregates More Than 0.84 mm (wt.%)	Wind Erodibility Index (I) (tons/ac/yr)
1	Very fine sand, fine sand, sand or coarse sand[2]	1 2 3 5 7	310 250 220 180 160
2	Loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand; very fine sandy loam and silt loam with 5 or less percent clay and 25 or less percent very fine sand; and sapric soil materials (as defined in Soil Taxonomy); except Folists	10	134
3	Very fine sandy loam (but does not meet WEG criterion 2), fine sandy loam, sandy loam, coarse sandy loam; noncalcareous silt loam that has greater than or equal to 20 to less than 50 percent very fine sand, and greater than or equal to 5 to less than 12 percent clay.	25	86
4	Clay, silty clay, noncalcareous clay loam that has more than 35 percent clay; noncalcareous silty clay loam that has more than 35 percent clay and does have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high iron oxide content).	25	86
4L	Calcareous[6] loam, calcareous silt loam, calcareous silt, calcareous sandy clay, calcareous sandy clay loam, calcareous clay loam and calcareous silty clay loam.	25	86
5	Noncalcareous loam that has less than 20 percent clay; noncalcareous silt loam with greater than or equal to 5 to less than 20 percent clay (b ut does not meet WEG criterion 3); noncalcareous sandy clay loam; noncalcareous sandy clay; and hemic materials (as defined in Soil Taxonomy).	40	56
6	Noncalcareous loam and silt loam that have greater than or equal to 20 percent clay; noncalcareous clay loam and noncalcareous silty clay loam that has less than or equal to 35 percent clay; silt loam that has parasesquic, ferritic, or kaolinitic mineralogy (high iron oxide content)	45	48
7	Noncalcareous silt; noncalcareous silty clay, noncalcareous silty clay loam, and noncalcareous clay that have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high content of iron oxide) and are Oxisols or Ultisols; and fibric material (as defined in Soil Taxonomy)	50	38
8	Soils not susceptible to wind erosion due to rock and pararock fragments at the surface and/or wetness; and Folists	--	0

1 For all WEGs except sands and loamy sand textures, if percent rock and pararock fragments (>2mm) by volume is 15-35, reduce "I" value by one group with more favorable rating. If percent rock and pararock fragments by volume is 35-60, reduce "I" value by two favorable groups except for sands and loamy sand textures which are reduced by one group with more favorable rating. If percent rock and pararock fragments is greater than 60, use "I" value of 0 for all textures except sands and loamy sand textures which are reduced by three groups with more favorable ratings. An example of more favorable "I" rating is next lower number - "I" factor of 160 to "I" factor of 134 or "I" factor of 86 to "I" factor of 56. The index values should correspond exactly to their wind erodibility group.

2 The "I" values for WEG 1 vary from 160 for coarse sands to 310 for very fine sands. Use an "I" of 220 as an average figure.

3 All material that meets criterion 3 in the requirements for andic soil properties in the Keys to Soil Taxonomy, 10^{th} edition, regardless of the fine earth texture, are placed in WEG 2.

4 All material that meets criterion 2, but not criterion 3, in the requirements for andic soil properties in the Keys to Soil Taxonomy, 10^{th} edition, regardless of the fine earth texture, are placed in WEG 6 except for medial classes of Cryic Spodosols having MAAT < 40 degrees F., which are placed in WEG 2.

5 Surface layers or horizons that do not meet andic soil properties criteria but do meet Vitrandic, Vitritorrandic, and Vitrixerandic subgroup criteria (thickness requirement excluded) move one group with less favorable rating.

6 Calcareous is a strongly or violently effervescent reaction of the fine-earth fraction to cold dilute (1N) HCL; a paper "Computing the Wind Erodible Fraction of Soils" by D. W. Fryear et.al (1994) in the J. Soil and Water Conservation 49 (2) 183-188 raises a yet unresolved question regarding the effect of carbonates on wind erosion.

7 For soils with thin "O" horizons on mineral soils, WEG is based on the first mineral horizon.

Exhibit 618-17 Key Landforms and Their Susceptibility to Slippage.

Topography	Landform or Geological Materials	Slippage Potential[A]
I. Level Terrain		
A. Not elevated	Floodplain, Till plain, Lake bed	3
B. Elevated		
1. Uniform Tones	Terrace, Lake bed	2
2. Surface irregularities, sharp cliff	Basaltic plateau	1
3.Interbedded-porous over impervious layers	Lake bed, coastal plain	1
II. Hilly Terrain		
A. Surface Drainage not well integrated		
1. Disconnected drainage	Limestone	3
2.Deranged drainage, overlapping hills, associated with lakes and swamps (glaciated areas only)	Moraine	2
B. Surface drainage well integrated		
1. Parallel ridges		
a. Parallel drainage, dark tones	Basaltic hills	1
b. Trellis drainage, ridge-and-valley topography, banded hills	Downslope tilted sedimentary rock	1
c. Pinnate drainage, vertical-sided gullies	Loess	2
2. Branching ridges, hilltops at common elevation		
a. Pinnate drainage. vertical-sided gullies	Loess	2
b. Dendritic drainage		
(1) Banding on slopes	Flat-lying sed. rocks	2
(2) No banding on slopes		
(a) Moderately to highly dissected ridges, uniform slopes	Clay Shale	1
(b) Low ridges associated with coastal features	Dissected coastal plains	1
(c) Winding ridges connection conical hills, sparse vegetation	Serpentinite	1
3. Random ridges or hills		
a. Dendritic drainage		
(1) Low, rounded hills meandering streams	Clay shale	1
(2) Winding ridges, connecting conical hills, sparse vegetation	Serpentinite	1
(3) Massive, uniform, rounded to A-shaped hills	Granite	2
(4) Bumpy topography (glaciated areas only)	Moraines	2
III. Level to Hilly Terrain		
A. Steep slopes	Talus, colluvium	1
B. Moderate to flat slopes	Fan, delta	3
C. Hummocky slopes with scarp at head	Old slide	1

A.
1 = susceptible to slippage (Unstable);
2 = susceptible to slippage under certain conditions (Moderately unstable);
3 = not susceptible to slippage except in vulnerable locations (Slightly unstable to stable).

Exhibit 618-18 Example Worksheets for Soil Moisture State by Month and Depth

SOIL MOISTURE STATE BY MONTH AND DEPTH

Aridic Thermic

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)	10	10	8	4	6	2	8	10	6	4	8	8
0 SOIL DEPTH 200 cm	M D	M D	M D	M D	D	D	D	D	D	D	D	M D

Xeric Mesic

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)	180	140	110	60	40	30	10	20	40	80	170	200
0 SOIL DEPTH 200 cm	M W	M W	M W	M	M	D M	D M	D M	M D M	M	M	W

Ustic Mesic

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)	10	15	50	60	80	100	70	70	70	40	25	15
0 SOIL DEPTH 200 cm	M D M	M D M	M D M	M	M	M	D M	D M	D M	M D M	M D M	M D M

Udic Mesic

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)	50	60	80	80	100	100	110	90	70	50	80	70
0 SOIL DEPTH 200 cm	M W	M W	M W	M W	M W	M	M	D M	D M	M	M W	M W

SOIL MOISTURE STATE BY MONTH AND DEPTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)												
0 **SOIL** DEPTH 200 cm												

SOIL MOISTURE STATE BY MONTH AND DEPTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)												
0 **SOIL** DEPTH 200 cm												

SOIL MOISTURE STATE BY MONTH AND DEPTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)												
0 **SOIL** DEPTH 200 cm												

SOIL MOISTURE STATE BY MONTH AND DEPTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ppt (mm)												
0 **SOIL** DEPTH 200 cm												

Part 620 - SOIL INTERPRETATIONS RATING GUIDES

CONTENTS

620.00 Definition.

(a) Soils are rated for specific uses identified as important or potentially important to users of soil survey information.

(b) The rating guides consist of two parts: (1) a narrative that explains the assumptions that are being made in the criteria and (2) the set of rules, properties, and evaluations that are used to make the soil rating.

(c) Restrictive features identify the soil property that creates the limitation for the specified use. The extent to which the restrictive feature affects the interpretation provides the user severity of the restriction from the one property.

620.01 Policy.

(a) Soil survey interpretation rating guides maintain the criteria for soil survey interpretations. Tables of soil interpretation ratings must reference the rating criteria used.

(b) Soils are rated in their current state, whether it is a "natural" or a modified state created by a land use management practice such as cultivation. Soils significantly altered should be identified as separate map unit components and interpreted in their current state.

(c) Interdisciplinary involvement is used in developing criteria for tables in order to assure that the needs of potential users are addressed. Guidance for writing soil interpretation criteria is provided in part 617.10. Development of the criteria is normally initiated during the early stages of implementation for new soil surveys or for an update of completed soil surveys through the memorandum of understanding, and follow-up is continued throughout the remainder of the process. Cooperators of the National Cooperative Soil Survey can submit proposals for changes or enhancements to the MLRA office.

(d) Tables of interpretations report the computer estimate from the rating criteria. Do not adjust the ratings. Ratings that are contrary to the experience of those persons familiar with the soil and other performance standards of users should be evaluated. If the performance of the soil is not consistent with the computer estimates, review the soil properties and selected criteria. Also review the assumptions and definition of the practice being rated.

(e) The National Soil Survey Center is responsible for leadership in the development of a system for making interpretations and for the preparation and maintenance of nationally supported guides for rating soils.

(f) Program areas and various disciplines determine the policy for acceptance or application of interpretation criteria for specific uses.

620.02 General.

(a) The soil interpretation rating guides are prepared for those who are making soil interpretations of specific soils. They are also useful to those who want to know the criteria that are used in making ratings of soil for various uses. The guides contain a description of the use and the rules, properties, and evaluations used to rate the soils.

(b) Steps in preparation of ratings. The following steps are suggested as a logical sequence for the preparation and presentation of soil ratings:

- -- Inform users, determine their needs, and initiate action.
- -- Identify the technical specialists who will participate.
- -- Hold conferences to review procedures and evaluate the adequacy of data. (Reference part 617.10 for guidance in writing the criteria.)
- -- Collect additional data if needed.
- -- Prepare soil potential ratings if desired. (See part 621.03.)
- -- Review and approve ratings as needed.
- -- Prepare ratings in final format.
- -- Distribute ratings.

(c) The kinds of soil interpretations needed in a soil survey may depend on the desires of the users and the cooperators. However, in most surveys a standard set of soil interpretations is requested. It is important that these interpretations are coordinated across political boundaries and between major land resource areas in order to assure consistency throughout the NCSS program. In order for soil survey interpretation ratings to be coordinated, the map units must be correlated across political boundaries and the soil properties must be estimated using the same procedure.

(d) The properties used in the rating criteria tables and the methods of measuring or estimating are described in part 618.

Part 620 - SOIL INTERPRETATIONS RATING GUIDES

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PART	TITLE	PAGE

620.00 Definition.

(a) Soils are rated for specific uses identified as important or potentially important to users of soil survey information. Important uses for which soils are rated include building site development, construction materials, recreational development, sanitary facilities, waste management, water management, and water quality.

(b) The rating guides consist of two parts: (1) a narrative that explains the assumptions that are being made in the criteria and (2) the criteria tables that list the soil and other related properties that are used to make the soil rating. Each rating is made using the most limiting criteria for that soil. The ratings are made for three or more classes according to their limitations or suitabilities for each given use.

(c) Restrictive features that may limit management alternatives are identified where the soil has a limitation for the specified use. The classes of soil ratings and associated restrictive features used in this part are defined in 620.02.

(d) Tables 620-1 through 620-36, except for tables 620-11 and 620-16, are criteria programmed at the Iowa State University Statistical Laboratory. Other tables have not been programmed that require soil properties not yet available. These tables are available for hand rating.

620.01 Policy.

(a) Coordination of interpretations are made in accordance with part 610 of the National Soil Survey Handbook. Interpretations are coordinated on the basis of a major land resource area.

(b) Soils are rated in their current state, whether it is a "natural" or a previously modified state; no unusual additional modification of the soil site or soil material is made other than that which is considered normal practice for the rated use. Only the most restrictive features are listed in presenting soil interpretations.

(c) Interdisciplinary involvement is used in developing criteria for tables in order to assure that the needs of potential users are addressed. Guidance for writing soil interpretation criteria is provided in part 617.11. Development of the criteria is normally initiated during the early stages of implementation for new soil surveys or for an update of completed soil surveys through the memorandum of understanding, and follow-up is continued throughout the remainder of the process. Cooperators of the National Cooperative Soil Survey can submit proposals for changes or additions to criteria or new tables to the respective head of the soils staff at the national technical center. The National Soil Survey Center has final authority for comments and implementation.

(d) Tables are constructed to avoid the use of footnotes in order to facilitate computer use. Whenever possible, primary information is used as criteria for tables.

(e) Ratings are confirmed by those persons familiar with that soil and by the experience of users. If the performance of the soil is not consistent with the computer estimates, then the ratings need to be validated by field observations of the behavior of the soil. Local and State cooperating agencies and others are enlisted to obtain such supporting data. Ratings that deviate from the guide are acceptable if (1) the actual performance is documented to be different from the rating derived from the guide, (2) all states that use the series agree to the rating, and (3) a formal request is sent to the National Soil Survey Center after it is approved by the head of the soils staff at the national technical center.

(f) The National Soil Survey Center is responsible for leadership in the preparation and maintenance of standard guides for rating soils.

620.02 General.

(a) The soil interpretation rating guides given in this part are prepared for those who are making soil interpretations of specific soils. They are also useful to those who want to know the criteria that are used in making ratings of soil for various uses. These guides are used with a computer program called RATINGS which checks the ratings of soils in the national database. The guides contain a description of the use, the criteria used to rate the soils, and guide tables. The guide tables show in the first column the properties or features used as criteria for rating the soil for the use. The properties are listed in descending order of estimated importance. In the "Limits" column, limits of the properties are given for rating the soil and for recognizing a restrictive property or properties. The key phrase in the "Restrictive feature" column indicates the feature causing the limitation.

(b) Steps in preparation of ratings. The following steps are suggested as a logical sequence for the preparation and presentation of soil ratings:

- -- Inform users, determine their needs, and initiate action.
- -- Identify the technical specialists who will participate.
- -- Hold conferences to review procedures and evaluate the adequacy of data. (Reference part 617.11 for guidance in writing the criteria.)
- -- Collect additional data if needed.
- -- Prepare soil potential ratings. (See part 621.03.)
- -- Review and approve ratings as needed.
- -- Prepare ratings in final format.
- -- Distribute ratings.

(c) The kinds of soil interpretations needed in a soil survey may depend on the desires of the users and the cooperators. However, in most surveys a standard set of soil interpretations is requested. It is important that these interpretations are coordinated across political boundaries and between major land resource areas in order to assure consistency throughout the NCSS program. In order for soil survey interpretation rating criteria tables to be effective, a process must be set forth to encourage a uniform application of the rating tables. Also, there must be a constant incorporation of new ideas to take advantage of new technology and address the needs of the users and cooperators.

(d) The soil interpretations record (SCS-SOI-5) is an important tool for coordinating the information used in soil survey interpretations. An explanation of its importance and use is given in part 623 of this handbook. The properties used in the rating criteria tables and the methods of measuring or estimating are described in part 618.

620.03 Rating Terms.

Ratings for proposed uses are given in terms of limitations and restrictive features, suitability and restrictive features, or only restrictive features. Other features may be included for soil limitations that need to be overcome for a specific purpose.

(a) Limitation ratings.
A limitation rating identifies the degree of limitation that restricts the use of a site for a specific purpose.

(1) Slight. This rating is given to soils that have properties favorable for the use. This degree of limitation is minor and can be overcome easily. Good performance and low maintenance can be expected.

(2) Moderate. This rating is given to soils that have properties moderately favorable for the use. This degree of limitation can be overcome or modified by special planning, design, or maintenance. The expected performance of the structure or other planned use is somewhat less desirable than for soils rated slight.

(3) Severe. This rating is given to soils that have one or more properties unfavorable for the rated use. This degree of limitation generally requires major soil reclamation, special design, or intensive maintenance. Some of the soils, however, can be improved by reducing or removing the soil feature that limits use; but in most situations, it is difficult and costly to alter the soil or to design a structure so as to compensate for a severe degree of limitation.

(4) Very severe. States have an option to use very severe ratings within a survey area. Very severe is a subdivision of the severe rating, and the criteria used to separate moderate and severe must stand. A soil rated very severe has one or more features so unfavorable for the rated use that the limitation is very difficult and expensive to overcome. A rating of very severe should be confined to soils or soil materials that require extreme alteration and that, for the most part, are not used for the purposes being rated. An example is the use of a soil with bedrock at a depth of less than 20 inches for a septic tank filter absorption field.

(b) Suitability ratings.
A suitability rating identifies the degree that a soil is favorable for a given use.

(1) Good or well suited. The soil has properties favorable for the use. There are no soil limitations. Good performance and low maintenance can be expected. Vegetation or other attributes can easily be maintained, improved, or established.

(2) Fair or suited. The soil is moderately favorable for the use. One or more soil properties make these soils less desirable than those rated good or well suited. Vegetation or other attributes can be maintained, improved, or established; but a more intensive management effort is needed to maintain the resource base.

(3) Poor or poorly suited. The soil has one or more properties unfavorable for the use. Overcoming the unfavorable property requires special design, extra maintenance, or costly alteration. Vegetation or other attributes are difficult to establish or maintain.

(4) Unsuited. The expected performance of the soil is unacceptable for the use, or extreme measures are needed to overcome the undesirable properties or qualities. The unsuited rating is not used in current computer generated soil interpretation tables but may be used by soil survey areas within a state.

620.04 Restrictive Features.

The terms for restrictive features are used to identify soil properties that restrict or limit the use of a soil for a specific purpose. The restrictive features are intended to assist users in identifying soil features important for use and management. Some of the terms are self-explanatory, others need explanation to help readers make maximum use of the information. The following is a list of terms and approved definitions:

AREA RECLAIM An area difficult to reclaim after the removal of soil for construction and other uses.

CEMENTED PAN Restrictive, dense, hard, somewhat impervious cemented soil material.

CUTBANKS CAVE The walls of excavation tend to cave in or slough.

DEEP TO PERMAFROST Depth to the permafrost layer is deeper than required to maintain a shallow perched water table and supply moisture to shallow rooted tundra vegetation.

DEEP TO WATER Deep to permanent water table during dry season.
DENSE LAYER Layer is too dense for intended use.

DEPTH TO ROCK Bedrock is too near the surface for the specified use.

DEPTH TO SOFT ROCK Soft rock is too near the surface for the specified use.

DRAINAGE ARTIFICIAL Discharge water from artificial drainage may adversely affect water quality.

DROUGHTY Soil holds too little water for plants during dry periods.

DUSTY Soil particles detach easily and cause dust.

ERODES EASILY Soil is easily eroded by water.

EXCESS FINES Excess silt and clay in the soil. The soil does not provide an economic source of gravel or sand for construction purposes.

EXCESS GYPSUM Excess gypsum in the soil may cause problems with subsidence, piping, seepage, and corrosion of steel or concrete.

EXCESS HUMUS Too much organic matter.

EXCESS LIME Excess carbonates in the soil that restrict the growth of some plants.

EXCESS PERMEABILITY Excess loss of water through subsurface discharge.

EXCESS RUNOFF Excess loss of water through surface discharge.

EXCESS SALT Excess water-soluble salts in the soil that restrict the growth of most plants.

EXCESS SODIUM Excess exchangeable sodium, which imparts poor physical properties that restrict the growth of plants.

EXTREME SOIL TEMPERATURES The soil climate is either too hot or too cold or the soil has summer temperatures that are too cool during the growing season for unrestricted vegetative growth.

EXCESS SULFUR Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

FAST INTAKE The rapid movement of water into the soil.

FAVORABLE Features of the soil are favorable for the intended use.

FLOODING Soil flooded by moving water from stream overflow, runoff, or high tides.

FRAGILE Soil that is easily damaged by use or disturbance.

FRAGMENTAL Having excess rock fragments greater than or equal to 2 mm.

FROST ACTION Freezing and thawing of soil moisture. Frost action can damage roads, buildings, and other structures.

HARD TO PACK Difficult to compact using regular earthwork construction equipment.

HIGH AVAILABLE WATER CAPACITY Soils hold relatively large quantities of water that is readily available to plants.

INFREQUENT FLOODING Flooding occurs at an interval that limits riparian plant species.

LARGE STONES Rock fragments 3 inches or more across adversely affect the specified use of soil.

LOOSE MATERIAL Unconsolidated soil materials, such as sand.

LOW ADSORPTION Low amounts of cations are adsorbed from wastes applied to the soil.

LOW CEC The cation exchange capacity is low enough to affect plant growth.

LOW FERTILITY Fertility is low enough to adversely affect the growth of most crops.

LOW ORGANIC MATTER Organic matter at levels too low for optimum production of most crops.

LOW SALT Amounts of salt are too low for satisfactory growth of desired salt-tolerant plants.

LOW SODIUM Amounts of sodium are too low for satisfactory growth of desired sodium-tolerant plants.

LOW STRENGTH The soil has a low resistance to deforming, sliding, or failure; its low resistance affects its suitability for the intended use. The soil is not strong enough to support loads.

NO WATER Too deep to ground water.

NON-DURABLE Soil that, according to its classification or texture, normally performs satisfactorily but contains natural material or particles that are subject to break down and can cause a change of properties or performance over time.

ORGANIC An excess amount of organic matter that adversely affects the properties of the soil.

PERCS SLOWLY The slow movement of water through the soil adversely affects the specified use.

PERMAFROST Layers of soil in which a temperature below freezing exists continuously.

PIPING The formation of subsurface tunnels or pipe like cavities by water eroding the soil as it moves through it.

PITTING Pits that form on the soil as a result of ice melt after plant cover is removed.

PONDING Standing water on soils in closed depressions that is removed only by percolation or evapotranspiration.

POOR FILTER Effluent moves through the soil too rapidly for adequate filtration or treatment.

PROLONGED FLOODING Floodwater saturates and remains on the soil surface for extended periods of time, adversely affecting vegetation.

RAPID DRAINAGE The rapid removal of excess water, internally or externally, from the soil.

RESTRICTIVE LAYER A soil or rock layer that inhibits the movement of water and/or roots through the soil.

ROCK FRAGMENTS Fragments that reduce the moisture and nutrient capacity of the soil.

ROOTING DEPTH Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

RUNOFF The surface discharge of water that does not enter the soil.

SALTY WATER Water that is too salty for consumption by livestock.

SEEPAGE The movement of water through the soil. Seepage adversely affects the specified use.

SHALLOW TO WATER The water table is at a depth that affects use and management for most applications.

SHRINK-SWELL The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

SLIPPAGE Soil mass susceptible to movement downslope when loaded, excavated, or wet.

SLOPE Slope is steep enough that special practices are required to ensure satisfactory performance of the soil for a specified use.

SLOW INTAKE The slow movement of water into the soil.

SLOW REFILL The slow filling of aquifer-fed ponds, resulting from restricted permeability in the soil.

SMALL STONES Rock fragments 2 mm to 76 mm in diameter. Small stones adversely affect the specified use of the soil.

SOIL BLOWING Soil easily moved by wind.

STABILITY Soil has the capacity to resist detachment or slippage.

STONINESS Soil has stones that interfere with its use and management.

SUBSIDES Settlement of organic soils, of soils containing semifluid layers, or of materials that dissolve in solution.

THIN LAYER Otherwise suitable soil material is too thin for the specified use or management.

THIN SURFACE A thin surface horizon that limits the specified use and management.

TOO ACID The soil is so acid that growth of plants is restricted.

TOO ALKALINE The soil is so alkaline that growth of plants is restricted.

TOO ARID The soil is dry most of the time, and vegetation is difficult to establish.

TOO BOULDERY The soil has boulders that interfere with use or management.

TOO CLAYEY The soil is slippery and sticky when wet and slow to dry.

TOO COBBLY The soil has excess cobbles that affect its performance for a given use.

TOO COLD Soils have temperatures too low for the intended use or management.

TOO GRAVELLY The soil has excess gravel that affects its performance for a given use.

TOO MOIST Distribution, pattern, and total amount of precipitation exceed the soil moisture requirements of most desertic vegetation.

TOO SANDY The soil is soft and loose, droughty, and low in fertility or is too fine to use as gravel.

TOO STONY The soil has excess stones that affect its performance for a given use.

UNSTABLE Soils are subject to failure under load.

WETNESS The soil is wet during the period of desired use.

Soil interpretations requested for a specific land use have a unique set of rating terms that identify either the limitation or the suitability of the soil for that purpose. Select soil properties or features are key components of the rating criteria used to rate each interpretation. Only the applicable restrictive feature phrase that relates to each soil property evaluated is used.

620.05 Building Site Development.

(a) General.

(1) The soil interpretations for building site development are designed to be used as a tool in evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its present condition and does not consider present land use. The limitation rating provided in each interpretation is based on the influence of existing soil properties for that use. For each soil, the rating identifies the degree of limitation, such as slight, moderate, or severe. If the soil has a slight limitation for a specific use, no restrictive feature is noted.

(2) The restrictive feature(s) is identified for each moderate or severe limitation rating as it affects the design of structures and the construction techniques to be used. The restrictive feature(s) also determines the performance to be expected after construction and the kind and degree of future maintenance required. Minor restrictive soil features are not identified or considered as part of the initial rating process but could be important factors where the major restrictive features are overcome through design application.

(3) Use of the soil interpretation rating guides in the planning and evaluation process allow the user to identify and recommend site selection and to plan alternative measures that minimize impacts on the soil resource.

(4) Applications of building site interpretations initially gives many users the impression that the ratings will only be useful where urban development is planned or currently underway. This impression usually leads to non-use and ultimately reduces the opportunity to apply these interpretations to other similar situations that are common to site evaluation and the planning process. Opportunities do exist for expanding the use of each guide used in rating soils for building site development. The potential application may not be entirely urban, in the truest sense, but is applicable just the same. Some probable applications may involve planning for irrigation or other water pipeline trenches; cable trenches; farm or ranch homesteads; rural housing development; silage pits; silo foundations; barn or outbuilding foundations; outbuildings for recreational uses; and livestock or wildlife watering facility pads and tanks.

(5) Sometimes a change in the heading of the interpretation table will broaden its use. However, one should be careful that the change does not alter or diminish the intent or value of the soil interpretation rating guide, such as a change from shallow excavations to shallow trenches. To obtain expanded use of the soil survey interpretation rating guides, the user may request through the proper channels that the present interpretation headings be repackaged to better represent the local needs.

(6) Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. Soil limitation ratings of slight, moderate, and severe are given for shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, lawns, landscaping, and golf fairways.

(b) Shallow excavations.

(1) Shallow excavations are trenches or holes dug in the soil to a maximum depth of 5 or 6 feet. They are used for pipelines, sewer lines, telephone and power transmission lines, basements, open ditches, grave sites, etc. The excavations are most commonly made by trenching machines or backhoes.

(2) Table 620-1 displays the soil properties and qualities, limits, and restrictive features used in rating soils for shallow excavations. The ratings are based on the soil properties that influence ease of digging and resistance to sloughing. Depth to bedrock or cemented pan, hardness of bedrock or a cemented pan, and the amount of large stones influence the ease of digging, filling, and compacting. Depth to the seasonal high water table and flooding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture and depth to water table influence the resistance to sloughing.

Table 620-1 Shallow Excavations.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	DEPTH TO HARD BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
1a.	DEPTH TO SOFT BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
2.	DEPTH TO CEMENTED PAN THICK (IN)	>60	40-60	<40	CEMENTED PAN
2a.	DEPTH TO CEMENTED PAN THIN (IN)	>40	20-40	<20	CEMENTED PAN
3.	USDA TEXTURE	---	---	ICE	PERMAFROST
3a.	TEXTURE (20-60")	---	SI (IF NOT LOESS)	COS, S, FS, VFS, LCOS, LS, LFS, SG, LVFS, G	CUTBANKS CAVE
3b.	TEXTURE (20-60") (IF NOT OXIC SUBGROUP, OXISOL, KANDHAPL OR KANDI GREAT GROUP, KAOLINITIC MINERALOGY)	---	SIC, C	---	TOO CLAYEY
4.	SOIL ORDER UNIFIED	---	---	VERTISOLS	CUTBANKS CAVE
5.	UNIFIED (20-60")	---	---	OL, OH, PT	EXCESS HUMUS
6.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 40")	<25	25-50	>50	LARGE STONES
7.	PONDING	---	---	+	PONDING
8.	DEPTH TO HIGH WATER TABLE (FT)	>6	2.5-6	<2.5	WETNESS
9.	FLOODING	NONE, RARE	OCCAS, FREQ		FLOODING
10.	SLOPE (PCT)	<8	8-15	>15	SLOPE
11.	BULK DENSITY (G/CC) (20-60")	---	>1.8	---	DENSE LAYER

(c) Dwellings without basements.

(1) Dwellings without basements are single-family houses of three stories or less without basements. The foundation is assumed to be spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper.

(2) Table 620-2 has rating criteria that are based on soil properties and qualities affecting the capacity of soil to support a load without movement and on those that affect excavation and construction costs. The properties and qualities affecting load-supporting capacity without movement are the presence of a high water table, flooding, and the shrink-swell behavior and compressibility of the soils. Compressibility is inferred from the Unified classification. Properties influencing the ease and amount of excavation are a seasonal high water table, slope, depth to bedrock or to a cemented pan, and the amount and size of rock fragments.

Table 620-2 Dwellings Without Basements.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE (IN)	---	---	>12	SUBSIDES
3.	FLOODING	NONE	---	RARE, OCCAS, FREQ	FLOODING
4.	PONDING	---	---	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
6.	SHRINK-SWELL (LE) (THICKEST LAYER 10-40", PCT)	LOW (<3)	MODERATE (3-6)	HIGH, VERY (>6) HIGH	SHRINK-SWELL
7.	UNIFIED (THICKEST LAYER 10-40")	---	---	OL, OH, PT	LOW STRENGTH
8.	SLOPE (PCT)	<8	8-15	>15	SLOPE
9.	DEPTH TO HARD BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
9a.	DEPTH TO SOFT BEDROCK (IN)	>20	<20	---	DEPTH TO ROCK
10.	DEPTH TO CEMENTED PAN THICK (IN)	>40	20-40	<20	CEMENTED PAN
10a.	DEPTH TO CEMENTED PAN THIN (IN)	>20	<20	---	CEMENTED PAN
11.	WEIGHT PERCENT >3" (WEIGHT AV. 0-40")	<25	25-50	>50	LARGE STONES

(d) Dwellings with basements.

(1) Dwellings with basements are single-family houses of three stories or less with basements. The foundation is assumed to be spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

(2) The ratings that are based on Table 620-3 support properties and qualities that affect the capacity of a soil to bear a load without movement and those that affect excavation and construction costs. The properties affecting load supporting capacity without movement are presence of a seasonal high water table, flooding, and the shrink-swell behavior and compressibility of the soils. Compressibility is inferred from the Unified classification. Properties influencing the ease and amount of excavation are flooding, a high water table, slope, depth to bedrock or to a cemented pan, and the amount and size of coarse fragments.

Table 620-3 Dwellings With Basements.

PROPERTY	LIMITS: SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. USDA TEXTURE	---	---	ICE	PERMAFROST
2. TOTAL SUBSIDENCE (IN)	---	---	>12	SUBSIDES
3. FLOODING	NONE	---	RARE, OCCAS, FREQ	FLOODING
4. PONDING	---	---	+	PONDING
5. DEPTH TO HIGH WATER TABLE (FT)	>6	2.5-6	<2.5	WETNESS
6. DEPTH TO HARD BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
6a. DEPTH TO SOFT BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
7. DEPTH TO CEMENTED PAN THICK (IN)	>60	40-60	<40	CEMENTED PAN
7a. DEPTH TO CEMENTED PAN THIN (IN)	>40	20-40	<20	CEMENTED PAN
8. SLOPE (PCT)	<8	8-15	>15	SLOPE
9. SHRINK-SWELL (LE) (THICKEST LAYER 10-60", PCT)	LOW (<3)	MODERATE (3-6)	HIGH, VERY (>6) HIGH	SHRINK-SWELL
10. UNIFIED (BOTTOM LAYER)	---	---	OL,OH, PT	LOW STRENGTH
11. WEIGHT PERCENT >3" (WEIGHT AV. 0-40")	<25	25-50	>50	LARGE STONES

(e) Small commercial buildings.

(1) Small commercial buildings are those buildings that are less than three stories without basements. The foundation is assumed to be spread footings of reinforced concrete at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper.

(2) Table 620-4 lists the properties and qualities used in rating undisturbed soils. The ratings are based on properties and qualities affecting the capacity of the soil to support a load without movement and those that affect excavation and construction costs. The properties and qualities affecting load-supporting capacity without movement are presence of a high water table, flooding, and the shrink-swell behavior and compressibility of the soils. Compressibility is inferred from the Unified classification. Properties influencing the ease and amount of excavation are flooding, a high water table, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of coarse fragments.

Table 620-4 Small Commercial Buildings.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE	---	---	>12	SUBSIDES
3.	FLOODING	NONE	---	RARE, OCCAS, FREQ	FLOODING
4.	PONDING	---	---	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
6.	SHRINK-SWELL (LE) (THICKEST LAYER 10-40", PCT)	LOW (<3)	MODERATE (3-6)	HIGH, VERY (>6) HIGH	SHRINK-SWELL
7.	SLOPE (PCT)	<4	4-8	>8	SLOPE
8.	UNIFIED (THICKEST LAYER 10-40")	---	---	OL,OH, PT	LOW STRENGTH
9.	DEPTH TO HARD BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
9a.	DEPTH TO SOFT BEDROCK (IN)	>20	<20	--	DEPTH TO SOFT ROCK
10.	DEPTH TO CEMENTED PAN THICK (IN)	>40	20-40	<20	CEMENTED PAN
10a.	DEPTH TO CEMENTED PAN THIN (IN)	>20	<20	---	CEMENTED PAN
11.	WEIGHT PERCENT >3" (WEIGHT AV. 0-40")	<25	25-50	>50	LARGE STONES

(f) Local roads and streets.

(1) Local roads and streets are those roads and streets that have all-weather surfacing (commonly of asphalt or concrete) and that are expected to carry automobile traffic year-round. The roads and streets consist of (1) the underlying local soil material, either cut or fill, which is called "the subgrade"; (2) the base material, which may be lime-stabilized soil, cement-stabilized soil, gravel, or crushed rock; and (3) the actual road surface or street pavement, which is either flexible (asphalt), rigid (concrete), or gravel with binder in it. They are graded to shed water, and conventional drainage measures are provided. With the probable exception of the hard surface, roads and streets are built mainly from the soil at hand.

(2) Table 620-5 lists the properties and qualities used to rate soils for local roads and streets. The properties and qualities that affect local roads and streets are those that influence the ease of excavation and grading and the traffic-supporting capacity. The properties and qualities that affect the ease of excavation and grading are hardness of bedrock or a cemented pan, depth to bedrock or a cemented pan, depth to a water table, flooding, the amount of large stones, and slope. The properties that affect traffic-supporting capacity are soil strength as inferred from the AASHTO group index and the Unified classification, subsidence, shrink-swell behavior, potential frost action, and depth to the seasonal high water table.

Table 620-5 Local Roads and Streets.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE (IN)	---	---	>12	SUBSIDES
3.	DEPTH TO HARD BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
3a.	DEPTH TO SOFT BEDROCK (IN)	>20	<20	--	DEPTH TO SOFT ROCK
4.	DEPTH TO CEMENTED PAN THICK (IN)	>40	20-40	<20	CEMENTED PAN
4a.	DEPTH TO CEMENTED PAN THIN (IN)	>20	<20	---	CEMENTED PAN
5.	SHRINK-SWELL (LE) (THICK LAYER 10-40", PCT)	LOW (<3)	MODERATE (3-6)	HIGH, VERY (>6) HIGH	SHRINK-SWELL
6.	AASHTO GROUP INDEX NUMBER (THICKEST LAYER 10-40")	<5	5-8	>8	LOW STRENGTH
6a.	AASHTO GROUP INDEX	<5	5-8	>8	LOW STRENGTH
7.	PONDING	---	---	+	PONDING
8.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.0-2.5	<1.0	WETNESS
9.	SLOPE (PCT)	<8	8-15	>15	SLOPE
10.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
11.	POTENTIAL FROST ACTION	LOW	MODERATE	HIGH	FROST ACTION
12.	WEIGHT PERCENT >3" (WEIGHT AV. 0-40")	<25	25-50	>50	LARGE STONES

(g) Lawns, landscaping, and golf fairways.

(1) The soils are rated for their use in establishing and maintaining turf for lawns and golf fairways and ornamental trees and shrubs for residential or commercial landscaping. The ratings are based on the use of soil material at the location that may have some land smoothing. Irrigation may or may not be needed and is not a criterion in rating. Traps, trees, roughs, and greens are not considered as part of the golf fairway.

(2) The soil properties and qualities considered in rating soils for lawns, landscaping, and golf fairways include those that affect growth and trafficability after vegetation is established. They are shown in Table 620-6. The properties that affect plant growth are the content of salt, sodium, or calcium carbonate; sulfidic materials; soil reaction; depth to the water table; depth to bedrock or a cemented pan; and the available water capacity in the upper 40 inches of soil. The properties that affect trafficability after vegetation is established are flooding, wetness, slope, stoniness, and the amount of clay, sand, or organic matter in the surface layer.

Table 620-6 Lawns, Landscaping, and Golf Fairways.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (SURFACE LAYER)	---	---	SIC, C, SC	TOO CLAYEY
1b.	TEXTURE (SURFACE LAYER)	---	---	FB, HM, MUCK SP, MPT, PEAT	EXCESS HUMUS
1c.	TEXTURE (SURFACE LAYER)	---	LCOS, S	COS	TOO SANDY
2.	WEIGHT (PCT) SURFACE LAYER 2MM- 3"	<25	25-50	>50	SMALL STONES
2a.	WEIGHT (PCT) SURFACE LAYER >3"	<5	5-30	>30	LARGE STONES
3.	PONDING	---	---	+	PONDING
4.	SALINITY (MMHOS/CM) (SURFACE LAYER)	<4	4-8	>8	EXCESS SALT
5.	SODIUM ADSORPTION RATIO	---	---	>12	EXCESS SODIUM
6.	SOIL REACTION (pH)	---	---	<3.5	TOO ACID
7.	SULFIDIC MATERIALS (GREAT GROUP)	---	---	SULFAQUENTS, SULFIHEMISTS	EXCESS SULFUR
8.	DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	<1	WETNESS
9.	AVAILABLE WATER CAPACITY (IN/IN, WEIGHTED AV. OF MIDPOINTS TO 40")	>.10	.05-.10	<.05	DROUGHTY
10.	FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
11.	SLOPE (PCT)	<8	8-15	>15	SLOPE
12.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
13.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
14.	CALCIUM CARBONATE EQUIVALENT (PCT) (0-40")	---	---	>40	EXCESS LIME

620.06 Construction Material.

(a) General.

(1) Soil survey interpretations for construction materials are made to provide guidance to users in selecting the site of a potential source. Individual soils or groups of soils may be selected as potential source materials because their source is close at hand, is the only source available, or meets some or all of the physical or chemical properties required for the intended application. In theory every soil may be used as source materials, but in reality only a few soils have the profile characteristics that meet the defined criteria and performance requirements when rated for a specific propose. The use of rating guides can provide the user a means to select potential sites for further evaluation.

(2) As a part of the soil survey process, each soil is rated in its present condition. Suitability ratings and associated restrictive features are given for roadfill, topsoil, and soil reconstruction material. Ratings of probable and improbable sources of material are given for sand and gravel. The ratings do not consider the quality of the source material because quality depends on how the source material is to be used. Final site evaluation and site selection require an onsite inspection to determine the suitability of the materials for the intended purpose. Implementation of these interpretations helps to minimize the need for excessive random exploratory investigation by pinpointing potential sites.

(3) Soil interpretations for construction material have a potential for broader application by the user than the name implies. The use of these interpretations in planning may include various needs directed towards urban and rural development. The interpretations may apply to farm and ranch operations; stockpiling materials for borrow pits and new mine reclamation; source material used to rehabilitate areas of soil disturbance; thin layer cover material for parking areas, roads, trails etc.; and other uses. Where the present headings for the interpretations do not meet desired application in the local area, the user may request a change to the headings. Caution should be exercised to ensure that the proposed changes are within the original intent of the original interpretation guides.

(4) Soils are rated as sources for roadfill, topsoil, sand, gravel, and soil reconstruction material used for drastically disturbed areas. Suitability ratings of good, fair, or poor and restrictive features are given for soils used as a source of roadfill and topsoil. Ratings of probable and improbable are given for soils used as a source of sand and gravel. A rating of probable means that, on the basis of the available evidence, the source material is likely to be in or below the soil. A rating of improbable means that the source material is unlikely to be in or below the soil. The ratings do not consider the quality of the source material because quality depends on how the source material is to be used.

(b) Roadfill.

(1) Roadfill consists of soil material that is excavated from its original position and used in road embankments elsewhere. The evaluations for roadfill are for low embankments that generally are less than 6 feet in height and are less exacting in design than high embankments, such as those along superhighways. The rating is given for the whole soil, from the surface to a depth of about 5 feet, based on the assumption that soil horizons will be mixed in loading, dumping, and spreading. In Table 620-7 criteria, limits, and restrictive features for rating soils for local roads and streets are given. Soils are rated as to the amount of material available for excavation, the ease of excavation, and how well the material performs after it is in place.

(2) Soil properties that affect the amount of material available for excavation are thickness of suitable material above bedrock or other material that is not suitable. The percent of coarse fragments more than 3 inches in diameter, the depth to a seasonal high water table, and the slope are properties that influence the ease of excavation. How well the soil performs in place is indicated by the AASHTO classification and group index and by the shrink-swell potential. A high content of gypsum can cause piping or pitting. Some damage to the borrow area is expected; but if revegetation and erosion control are likely to be difficult, the soil is rated severe.

Table 620-7 Roadfill.

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	GOOD	FAIR	POOR	
1. USDA TEXTURE	---	---	ICE	PERMAFROST
2. DEPTH TO BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
3. DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
4. SHRINK-SWELL (LE) (THICKEST LAYER 10-60" BEST RATING, PCT)	LOW (<3)	MODERATE (3--6)	HIGH, VERY (>6) HIGH	SHRINK-SWELL
5. AASHTO GROUP INDEX NUMBER (THICKEST LAYER 10-60" BEST RATING)	<5	5-8	>8	LOW STRENGTH
6. LAYER THICKNESS (IN)	>60	30-60	<30	THIN LAYER
7. WEIGHT PERCENT >3" (WEIGHT AV. 0-40")	<25	25-50	>50	LARGE STONES
8. DEPTH TO HIGH WATER TABLE (FT)	>3	1-3	<1	WETNESS
9. SLOPE (PCT)	<15	15-25	>25	SLOPE

(c) Sand source.

Sand as a construction material is usually defined as particles ranging in size from 0.074 mm (sieve #200) to 4.75 mm (sieve #4) in diameter. Sand is used in great quantities in many kinds of construction. Specifications for each purpose vary widely. The intent of this rating is to show only the probability of finding material in suitable quantity. The suitability of the sand for specific purposes is not evaluated. The properties used to evaluate the soils as a probable source of sand are the grain size as indicated by the Unified soil classification, the thickness of the sand layer, and the amount of rock fragments in the soil material. They are listed in Table 620-8. If the lowest layer of the soil contains sand, the soil is rated as a probable source regardless of thickness. The assumption is that the sand layer below the depth of observation exceeds the minimum thickness.

Table 620-8 Sand Source.

	PROPERTY	LIMITS: PROBABLE	LIMITS: IMPROBABLE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	ICE	PERMAFROST
2a.	UNIFIED (THICKEST LAYER 10-60" AND LOWEST LAYER BEST RATING)	SW, SP, SW-SM, SP-SM		
2b.	UNIFIED (THICKEST LAYER 10-60" AND LOWEST LAYER BEST RATING) % PASSING # 4 MINUS #200 SIEVE >25	GW, GP, GW-GM, GP-GM		
2c.	UNIFIED (THICKEST LAYER 10-60" AND LOWEST LAYER BEST RATING) % PASSING # 4 MINUS #200 SIEVE <25		GW, GP, GW-GM, GP-GM	SMALL STONES
2d.	UNIFIED		PT	EXCESS HUMUS
2e.	UNIFIED		ALL OTHER	EXCESS FINES
3.	LAYER THICKNESS (IN)	>36	<36"	THIN LAYER
4.	WEIGHT PERCENT >3" (THICKEST LAYER 10-60")	<50	>50	LARGE STONES

(d) Gravel source.

(1) Gravel as a construction material is defined as particles ranging in size from 4.76 mm (sieve #4) to 76 mm (3 inches) in diameter. Gravel is used in great quantities in many kinds of construction. Specifications for each purpose vary widely. The intent of this rating is to show only the probability of finding material in suitable quantity. The suitability of the gravel for specific purposes is not evaluated.

(2) The properties used to evaluate the soil as a probable source of gravel (Table 620-9) are grain size as indicated by the Unified soil classification, the thickness of the gravel layer, and the amount of rock fragments in the soil material. If the lowest layer of the soil contains gravel, the soil is rated as a probable source regardless of thickness. The assumption is that the gravel layer below the depth of observation exceeds the minimum thickness.

Table 620-9 Gravel Source.

	PROPERTY	LIMITS PROBABLE	LIMITS IMPROBABLE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	ICE	PERMAFROST
2.	UNIFIED (THICKEST LAYER 10-60" OR BOTTOM LAYER)	GW, GP, GW-GM, GP-GM		
2a.	UNIFIED (THICKEST LAYER 10-60" OR BOTTOM LAYER) 100% PASSING #4 SIEVE =>25	SW, SP, SW-SM, SP-SM		FAVORABLE
2b.	UNIFIED (THICKEST LAYER 10-60" OR BOTTOM LAYER) 100% PASSING #4 SIEVE <25		SW, SP, SW-SM, SP-SM	TOO SANDY
2c.	UNIFIED		PT	EXCESS HUMUS
2d.	UNIFIED		ALL OTHER	EXCESS FINES
3.	LAYER THICKNESS (0-72 IN)	>36	<36	THIN LAYER
4.	WEIGHT PERCENT >3" (THICKEST LAYER 10-60")	<50	>50	LARGE STONES

(e) Topsoil.

(1) The term "topsoil" has several meanings. As used here, the term describes soil material used to cover an area so as to improve soil conditions for the establishment and maintenance of adapted vegetation.

(2) Generally, the upper part of the soil, which is richest in organic matter, is most desirable for use as topsoil; however, material excavated from deeper layers is also used. In this rating, the upper 40 inches of soil material is evaluated for use as topsoil. In the borrow area, the material below 40 inches is evaluated for its suitability for plant growth after the upper 40 inches is removed.

(3) As shown in Table 620-10, the soil properties that are used to rate the soil as topsoil are those that affect plant growth; the ease of excavation, loading, and spreading; and the reclamation of the borrow area.

(4) The physical and chemical soil properties and qualities that influence plant growth are the presence of toxic substances, soil reaction, and those properties that are inferred from the soil texture, such as the available water capacity and fertility. The properties that influence the ease of excavation, loading, and spreading are the amount of rock fragments, slope, depth to the water table, soil texture, and thickness of suitable material. The properties that influence the reclamation of the borrow area are the slope, depth to the water table, amount of rock fragments, depth to rock, and the presence of toxic material.

Table 620-10 Topsoil.

	PROPERTY	LIMITS GOOD	FAIR	POOR	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (THICKEST LAYER 10-40")	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1b.	TEXTURE (THICKEST LAYER 0-40"), >3% ORGANIC MATTER AND <35% CLAY	SCL, CL, SICL	---		TOO CLAYEY
1c.	TEXTURE (THICKEST LAYER 0-40")	---	SCL, CL, SICL	SIC, C, SC	TOO CLAYEY
1d.	TEXTURE (THICKEST LAYER 0-40")	---	---	FB, HM, SP MPT, MUCK PEAT, CE	EXCESS HUMUS
2.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
3.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
4.	DEPTH TO BULK DENSITY >1.8 G/CC (IN)	>40	20-40	<20	AREA RECLAIM
5.	STONINESS CLASS	1	2	3,4,5	TOO STONY
6.	WEIGHT PERCENT 2mm-3" (0-40")	<5	5-25	>25	SMALL STONES
6a.	WEIGHT PERCENT >3" (0-40")	<5	5-25	>25	LARGE STONES
6b.	WEIGHT PERCENT 2mm-3" (40-72")	<25	25-50	>50	AREA RECLAIM
6c.	WEIGHT PERCENT >3" (40-72")	<15	15-30	>30	AREA RECLAIM
7.	SALINITY (THICKEST LAYER 0-40") MMHOS/CM	<4	4-8	>8	EXCESS SALT
8.	LAYER THICKNESS (IN)	>40	20-40	<20	THIN LAYER

Table 620-10 Topsoil (continued).

		LIMITS			
	PROPERTY	GOOD	FAIR	POOR	RESTRICTIVE FEATURE
9.	DEPTH TO HIGH WATER TABLE	---	---	<1	WETNESS
10.	SODIUM ADSORPTION RATIO (0-40")	---	---	>13	EXCESS SODIUM
11.	SOIL REACTION (pH, THICKEST LAYER 0-40")	---	---	<3.5	TOO ACID
12.	SLOPE (PCT)	<8	8-15	>15	SLOPE
13.	CALCIUM CARBONATE (PCT, 0-40")	---	---	>40	EXCESS LIME

(f) Soil reconstruction material for drastically disturbed areas.

(1) Soil reconstruction of areas drastically disturbed, as in surface mining, is the process of replacing layers of soil material or unconsolidated geologic material, or both, in a vertical sequence of such quality and thickness that a favorable medium for plant growth is provided.

(2) Most new state strip mine programs emphasize that the land surface be restored to about its natural configuration or better and that the soil be reconstructed to maintain or improve its suitability for the intended use. Thus, a knowledge of the soil and underlying material is needed to plan proper reconstruction operations of mined land. This guide for soil reconstruction material evaluates the material as a medium for plant growth. It can be used to rate any segment of the soil profile or unconsolidated geologic material that is thick enough to warrant consideration in planned soil reconstruction. For example, for named kinds of soil, it will be necessary for most purposes to rate the A horizon, the B horizon, and the C horizon separately. If they all rate good, there may be little justification for keeping them separate for soil reconstruction. If the A horizon is rated better than the B or C, then it generally should be kept separate, depending upon its thickness and the anticipated use of the land. This guide does not cover areas of quarry, pit, dredge, and older surface mine operations that require an offsite source of soil reconstruction material. The guide "Daily Cover for Sanitary Landfill" is useful to evaluate the material used in restoration for these operations.

(3) When the soil materials are properly used in reconstruction, a rating of good means that vegetation is relatively easy to establish and maintain, that the surface is stable and resists erosion, and that the reconstructed soil has good potential productivity. Material rated fair can be vegetated and stabilized by modifying one or more properties. Topdressing with better material or applications of soil amendments may be necessary for satisfactory performance. Material rated poor has such severe problems that revegetation and stabilization are very difficult and costly. Topdressing with better material is necessary to establish and maintain vegetation.

(4) The major properties that influence erosion and stability of the surface and the productive potential of the reconstructed soil are listed in the guide, shown as Table 620é11.

(5) Excessive amounts of substances that restrict plant growth, such as sodium, salt, sulfur, copper, and nickel, create problems in establishing vegetation and, therefore, also influence erosion and the stability of the surface. Other substances, such as selenium, boron, and arsenic, enter the food chain and are toxic to animals that eat the vegetation. Of all these substances, only sodium and salt are criteria in the guide. If relatively high levels of toxic substances are in the reconstruction material, the material should be rated poor. Laboratory tests may be needed to properly identify toxic substances.

(6) Materials that are extremely acid or have the potential upon oxidation of becoming extremely acid are difficult and expensive to vegetate. They also contribute to poor water quality, in runoff or in ground water. Materials high in pyrite and marcasite without offsetting bases have high potential acidity. Laboratory tests may be needed to properly identify these materials.

(7) Vegetation is difficult to establish on soils that have high pH. Many of these soils also have a high sodium adsorption ratio, which indicates potential instability and water transmission problems.

(8) The available water capacity also is important in establishing vegetation. Soils that have a low available water capacity may require irrigation for the establishment of vegetation.

(9) The stability of the soil depends upon its erodibility by water and wind and its strength. Water erodibility is indicated by the K factor; wind erodibility is rated according to the "I" value of the wind erodibility group. Potential slippage hazard is related to soil texture, and although other factors also contribute, the ratings of soil texture represent one important factor.

(10) Soil texture also influences a number of the properties listed above, such as available water capacity and erodibility by wind or water. Texture also influences soil structure and consistence, water intake rate, runoff, fertility, workability, and trafficability.

(11) The fraction 3-10 inches is a weight percentage of rock fragments in the material used for soil reconstruction. The amount and size of rock fragments influence the ease of excavation, stockpiling, and respreading and the suitability for the final use of the land. A certain amount of rock fragments can be tolerated depending upon their size and the intended use of the reclaimed area. If the size of rock fragments exceeds 10 inches, problems are more severe.

(12) This rating guide does not cover all the soil features considered in planning soil reconstruction, such as slope, thickness of material, ease of excavation, potential slippage hazard, and soil moisture regime. The slope of the original soil may influence the method of stripping and stockpiling reconstruction material, but it may have little effect on the final contour and, therefore, on the stability and productivity of the reconstructed soil. Therefore, slope is not used as a criterion in this guide.

(13) The thickness of material suitable for reconstruction and the ease of excavation are important criteria in planning soil reconstruction operations. However, they are so dependent on the method of mining operations that they cannot be used as criteria in this guide.

(14) Soil moisture regime, climate, and weather influence the kind of vegetation to plant and the rate of revegetative growth. They are not used as criteria because the relative ranking does not change with variable moisture regimes; that is, the best soil in a moist environment is the best soil in a dry environment. Furthermore, the soil may be irrigated to establish vegetation.

Table 620-11 Soil Reconstruction Material for Drastically Disturbed Areas.

		LIMITS			
	PROPERTY	GOOD	FAIR	POOR	RESTRICTIVE FEATURE
1.	SODIUM ADSORPTION RATIO	<4	4-13	>13	EXCESS SODIUM
2.	SALINITY (MMHOS/CM)	<8	8-16	>16	EXCESS SALT
3.	SOIL REACTION (pH, 0-40")	5.0-8.5	4.0-5.0	<4.0	TOO ACID
3a.	SOIL REACTION (pH, >40")	---	<4.0	---	TOO ACID
3b.	SOIL REACTION	---	---	>8.5	TOO ALKALINE
4.	AVAILABLE WATER CAPACITY (IN/IN)	>.10	.05-.10	<.05	DROUGHTY
5.	EROSION FACTOR (K)	<.35	>.35	---	ERODES EASILY
6.	WIND ERODIBILITY GROUP	---	---	1, 2	SOIL BLOWING
7.	TEXTURE	---	SCL, CL, SICL	C, SIC, SC	TOO CLAYEY
7a.	TEXTURE	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
8.	WEIGHT PERCENT 3-10"	<25	25-50	>50%	TOO COBBLY
8a.	WEIGHT PERCENT >10"	<5	5-15	>15	TOO STONY
9.	LAYER THICKNESS (IN)	>40	20-40	<20	THIN LAYER
10.	ORGANIC MATTER (PCT)	>1	0.5-1.0	<0.5	LOW FERTILITY
11.	CLAY ACTIVITY CEC/CLAY	>.24	.16-.24	<.16	LOW FERTILITY
12.	CALCIUM CARBONATE EQ (PCT)	<15	15-40	>40	EXCESS LIME

620.07 Recreational development.

(a) General.

(1) Soil interpretations for recreational development are to be used to guide the user in identifying and evaluating the suitability of the soil for specific recreational purposes. The soil survey interpretation rating guides are applicable to both heavily and sparsely populated areas, depending upon the objectives of the user. The ratings are for soils in their present condition and do not consider present land use. The limitation rating for each interpretation is based on the influence of existing soil properties for that use. When a soil is rated for each use, the degree of the limitation and the most restrictive soil features are identified. Restrictive features for soils with moderate or severe limitations require changes to the original design or the application of corresponding conservation practices, or both, to overcome the limitations. Soils with slight limitations require no additional measures other than the normal local procedures used in site development and maintenance.

(2) Many soil survey areas in sparsely populated parts of the country have soil surveys of lower intensity. While some general observations may be made, onsite evaluation is required before the final site is selected.

(3) Soils subject to flooding are limited, in varying degrees, for recreational use by the duration and frequency of flooding and the season when it occurs. Onsite assessment of the duration and frequency of flooding is essential in planning recreational facilities.

(4) The ratings do not consider location and accessibility of the area, size and shape of the area, scenic quality, the ability of the soil to support vegetation, access to water, potential available sites for water impoundment, and either access to public sewers or capacity of the soil to absorb septic tank effluent. These features are extremely important considerations in evaluating a site and making the final site selection.

(5) The use of other applicable interpretations made for building site development, construction material, sanitary facilities, and water management help the user to develop alternatives for use in making their final decision. Depending upon the recreational use objectives, soil interpretations for woodland suitability, wildlife habitat suitability, or potential native plant community should also be a consideration in the final planning analysis. These latter interpretations help to maintain the aesthetic integrity of the recreational site.

(b) Camp areas.

(1) Camp areas are tracts of land used intensively as sites for tents, trailers, campers, and the accompanying activities of outdoor living. Camp areas require such site preparation as shaping and leveling in the areas used for tents and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic.

(2) The soils are rated on the basis of soil properties listed in Table 620-12, that influence the ease of developing camping areas and the performance of the camping area after development. Soil properties that influence trafficability and promote the growth of vegetation after heavy use are important. For tent or remote camp sites, the limitations would be less restrictive.

(3) Slope, stoniness, and depth to bedrock or a cemented pan are the main concerns in developing camp areas. However, areas associated with picnic areas may have steep slopes and rough terrain for aesthetic purposes. For good trafficability, the surface of camp areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. Soil properties that influence trafficability are texture of the surface layer, wetness, permeability, and large stones. The limitations of slow permeability and clayey surface texture are not as severe in dry regions of the country; however, silty soils may be more of a problem because they are dusty. Soil properties that influence the growth of plants are depth to bedrock or a cemented pan, permeability, and presence of toxic materials. Soils that are subject to flooding are particularly hazardous for camp areas because of the danger to life and property.

(4) If the soil properties or vegetative conditions observed suggest the probability of damage by traffic, the soil is rated SEVERE and the restrictive feature is listed as FRAGILE.

Table 620-12 Camp Areas.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	---	STV, BYV CB, FL,	STX, BYX, CBX, FLX, CBV, FLV, CNX, CRX, SHX, SYX	LARGE STONES
1b.	TEXTURE (SURFACE LAYER)	---	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER) TOR, UST, ARID, XER, OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS	---	SC, SIC, C	---	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER)	LFS, LS WHEN FINER MATERIAL <20"	LCOS, VFS LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	---	SIL, SI, VFSL, L	---	DUSTY
2.	FLOODING	NONE	---	RARE, OCCAS, FREQ	FLOODING
3.	SLOPE (PCT)	<8	8-15	>15	SLOPE
4.	PONDING	---	---	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
6.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
7.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)	<25	25-50	>50	SMALL STONES
8.	PERMEABILITY (0-40", IN/H)	>0.6	0.06-0.6	<0.06	PERCS SLOWLY
8a.	PERMEABILITY (0-40", IN/H) TOR, UST, ARID, XER, SUBORDERS, GREAT GROUPS AND SUBGROUPS	≥0.06	<0.06		PERCS SLOWLY
9.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS

Table 620-12 Camp Areas (continued).

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
10. DEPTH TO BEDROCK (IN)			<20	DEPTH TO ROCK
11. DEPTH TO CEMENTED PAN (IN)			<20	CEMENTED PAN
12. SODIUM ADSORPTION RATIO	---	---	>13	EXCESS SODIUM
13. SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
14. SOIL REACTION (pH)	---	---	<3.5	TOO ACID

(c) Picnic areas.

(1) Picnic areas are natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking lots. Soils are rated on the basis of properties that influence the development costs of shaping the site, trafficability, and the growth of vegetation after development.

(2) Slope and stoniness are the main concerns in developing picnic areas. For good trafficability, the surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. As shown in Table 620-13, soil properties that influence trafficability are texture of the surface layer, wetness, permeability, and large stones. The limitations of slow permeability and clayey surface texture are not as severe in dry regions of the country; however, silty soils may be more of a problem because they are dusty. Soil properties that influence the growth of plants are depth to bedrock, permeability, and the presence of toxic materials.

(3) If the soil properties or vegetative conditions observed suggest the probability of damage by traffic, the soil is rated SEVERE and the restrictive feature is listed as FRAGILE.

Table 620-13 Picnic Areas.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (MODIFIER SURFACE)	---	STV, BYV CB, FL	STX, BYX, CBX, FLX, CBV, FLV, CNX	LARGE STONES
1b.	TEXTURE (SURFACE LAYER)	---	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER--TOR, UST, ARID, BOR, XER, OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS)	---	SC, SIC, C	---	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER, FINER MATERIAL ≥ 20")	---	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS,	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER--TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	---	SIL, SI, VFSL, L	---	DUSTY
2.	SLOPE (PCT)	<8	8-15	>15	SLOPE
3.	FLOODING	NONE, RARE, OCCAS	FREQ		FLOODING
4.	PONDING	---	---	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.0-2.5	<1.0	WETNESS
6.	PERMEABILITY (0-40", IN/H)	≥0.6	0.06-0.6	<0.06	PERCS SLOWLY
6a.	PERMEABILITY (0-40"--TOR, UST, ARID, BOR, XER SUBORDERS, GREAT GROUPS, AND SUBGROUPS)	≥0.06	<0.06		PERCS SLOWLY
7.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS
8.	WEIGHT PERCENT 2mm - 3" (SURFACE LAYER)	<25	25-50	>50	SMALL STONES

Table 620-13 Picnic Areas (continued).

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
9. SODIUM ADSORPTION RATIO	---	---	>13	EXCESS SODIUM
10. SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
11. SOIL REACTION (pH)	---	---	<3.5	TOO ACID
12. DEPTH TO BEDROCK (IN)			<20	DEPTH TO ROCK
13. DEPTH TO CEMENTED PAN (IN)			<20	CEMENTED PAN

(d) Playgrounds.

(1) Playgrounds are areas used intensively for games, such as baseball and football, and similar activities. Playgrounds require a nearly level soil that is free of stones and that can withstand heavy foot traffic and still maintain adequate vegetation. Soils are rated on the basis of properties that influence the cost of shaping, trafficability, and the growth of vegetation.

(2) Slope and stoniness are the main concerns in developing playgrounds. For good trafficability, the surface of playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. As shown in Table 620-14, soil properties that influence trafficability are texture of the surface layer, wetness, permeability, and large stones. The limitations of slow permeability and clayey surface texture are not as severe in dry regions of the country; however, silty soils may be more of a problem because they are dusty. Soil properties that influence the growth of plants are depth to bedrock, permeability, and the presence of toxic materials.

(3) If the soil properties or vegetative conditions observed suggest the probability of damage by traffic, the soil is rated SEVERE and the restrictive feature is listed as FRAGILE.

Table 620-14 Playgrounds.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	---	ST	STV, BYV, STX, BYX, CBX, FLX, CBV, FLV, CNX, CB, FL	LARGE STONES
1b.	TEXTURE (SURFACE LAYER)	---	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER; TOR, UST, ARID, OR XER SUBORDERS, GREAT GROUPS, AND SUBGROUPS)	---	SC, SIC, C	---	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER)	---	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER) TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS	---	SIL, SI, VFSL, L	---	DUSTY
2.	SLOPE (PCT)	<2	2-6	>6	SLOPE
3.	PONDING	---	---	+	PONDING
4.	DEPTH TO HIGH WATER TABLE (FT)	>2.5	1.5-2.5	<1.5	WETNESS
5.	FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
6.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)	<10	10-25	>25	SMALL STONES
7.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS
8.	DEPTH TO BEDROCK (>2% SLOPES; IN)	>40	20-40	<20	DEPTH TO ROCK
8a.	DEPTH TO BEDROCK (≤2% SLOPES; IN)	≥20	---	<20	DEPTH TO ROCK

Table 620-14. Playgrounds (Continued)

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
9.	DEPTH TO CEMENTED PAN (>2% SLOPES; IN)	>40	20-40	<20	CEMENTED PAN
10.	DEPTH TO CEMENTED PAN (≤2% SLOPES; IN)	≥20	---	<20	CEMENTED PAN
11.	PERMEABILITY (0-40", IN/H)	>0.6	0.06-0.6	<0.06	PERCS SLOWLY
11a.	PERMEABILITY (0-40"; TOR, UST, ARID, OR XER SUBORDERS, GREAT GROUPS, AND SUBGROUPS)	≥0.06	<0.06		PERCS SLOWLY
12.	SODIUM ADSORPTION RATIO	---	---	>13	EXCESS SODIUM
13.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
14.	SOIL REACTION (pH)	---	---	<3.5	TOO ACID

(e) Paths and trails.

(1) Paths and trails are used for walking, horseback riding, and similar uses and require little or no cutting or filling. The soils are rated based on the properties and qualities that influence trafficability and erodibility, as shown in Table 620-15.

(2) These soil properties and qualities are stoniness, wetness, texture of the surface layer, slope, flooding, erodibility, and, in dry regions, dustiness. If the soil properties or vegetative conditions observed suggest the probability of damage by traffic, the soil is rated SEVERE and the restrictive feature is listed as FRAGILE.

Table 620-15 Paths and Trails.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	---	STV, BYV	STX, BYX, CBX, FLX, CBV, FLV, CNX	TOO COBBLY
1b.	TEXTURE (SURFACE LAYER)	---	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER; TOR, UST, ARID, BOR, OR XER SUBORDERS, GREAT GROUPS, AND SUBGROUPS)	---	SC, SIC, C	---	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER)	---	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER; TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	---	SIL, SI, VFSL, L	---	DUSTY
2.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
3.	PONDING	---	---	+	PONDING
4.	DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	<1	WETNESS
5.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS
6.	SLOPE (PCT)	<15	15-25	>25	SLOPE
7.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)	---	---	>65	SMALL STONES
8.	WEIGHT PERCENT >3" (SURFACE LAYER)	<25	25-50	>50	LARGE STONES
9.	FLOODING	NONE, RARE, OCCAS	FREQ	---	FLOODING
10.	EROSION FACTOR (K) (SURFACE LAYER) ON SLOPES >8%	---	---	>.35	ERODES EASILY

(f) Off-road motorcycle trails.

(1) Off-road motorcycle trails are primarily for recreational use. Trails for other off-road vehicles may have similar criteria. Little or no preparation is done to the trail, and the surface is not vegetated or surfaced. Considerable compaction of the soil on the trail is expected.

(2) Soils are rated based on the properties and qualities that influence erodibility, revegetation, trafficability, and dustiness as shown in Table 620-16. Considerations for desirable off-road challenges are not included. The soil properties considered are stoniness, slope, wetness, texture of the surface layer, and flooding. Slope affects the soil erodibility. Large stones affect the configuration of the trail. Small stones affect trafficability. Wetness and flooding affect revegetation and frequency of use. Surface texture affects erodibility, trafficability, revegetation, and probability of dust. If conditions indicate traffic damage, the soil is rated SEVERE and the restrictive feature is listed as FRAGILE.

Table 620-16 Off-Road Motorcycle Trails.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE MODIFIER (SURFACE)	---	STV, BYV	STX, BYX, CBX, FLX, CBV, FLV, CNX	TOO COBBLY
1b.	TEXTURE (SURFACE LAYER)	---	---	SC, SIC, C	TOO CLAYEY
1c.	TEXTURE (SURFACE LAYER; TOR, UST, ARID, XER, OR OXI SUBORDERS, GREAT GROUPS, AND SUBGROUPS, OXISOLS)	---	SC, SIC, C	---	TOO CLAYEY
1d.	TEXTURE (SURFACE LAYER, FINER MATERIAL ≥ 20")	---	LCOS, VFS, LFS, LS	COS, S, FS	TOO SANDY
1e.	TEXTURE (SURFACE LAYER, FINER MATERIAL <20")	LFS, LS	LCOS, VFS	COS, S, FS	TOO SANDY
1f.	TEXTURE (SURFACE LAYER; TOR, ARID, OR XER SUBGROUPS & GREAT GROUPS)	---	SIL, SI, VFSL, L, ASHY	---	DUSTY
2.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
3.	PONDING	---	---	+	PONDING
4.	DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	<1	WETNESS
5.	UNIFIED (SURFACE)	---	---	PT	EXCESS HUMUS
6.	SLOPE (PCT)	<25	25-40	>40	SLOPE
7.	WEIGHT PERCENT 2 mm-3" (SURFACE LAYER)			>65	SMALL STONES
8.	FLOODING	NONE, RARE, OCCAS	FREQ	---	FLOODING

620.08 Sanitary Facilities.

(a) General.

(1) Soil interpretations for sanitary facilities are a tool for guiding the user in site selection for the safe disposal of household effluent and solid waste. The interpretation guides are applicable to both heavily populated and sparsely populated areas. The ratings are for soils in their present condition and do not consider present land use. The use of these soil interpretation guides for sanitary facilities is important in site selection to minimize the potential for pollution and health hazards in local or regional areas. Improper site selection, design, or installation may cause contamination of ground water, seepage to the soil surface, and contamination of stream systems from surface drainage or flood water. Potential contamination may be reduced or eliminated by installing systems designed to overcome or reduce the effects of the limiting soil property.

(2) The soil properties and qualities that affect use are those that influence the ease of excavation, absorption of effluent, seepage, permeability, and suitability of soil cover material. Many soil survey areas in sparsely populated parts of the country have only soil surveys of lower intensity. While some general observations may be made, onsite evaluation is required before the final site is selected.

(3) Soil limitation ratings and associated restrictive features are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings and restrictive features are given for daily cover for landfill.

(4) Farm and ranch homesteads, outbuildings, and recreational facilities require a means to safely dispose of effluent and solid waste. A plan that includes daily cover for landfill and added protection to reduce offsite pollution minimizes the potential hazard. The interpretative guide for the use of daily cover for landfill also has additional application for the reclamation of some quarries, pits, and surface mine operations. The use of this guide should also include an evaluation of the material used in restoration of the target areas for the final establishment of vegetative cover.

(5) Soil properties are important in selecting sites for septic tank absorption fields, sewage lagoons, and sanitary landfills and in identifying the limiting soil properties and site features that should considered in planning, design, and installation. The soil properties that determine the ease of excavation or the installation of the facilities also affect the ratings. Soil limitation ratings of slight, moderate, or severe are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of good, fair, and poor are given for daily cover for landfill.

(b) Septic tank absorption fields.

(1) Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. The centerline depth of the tile is assumed to be 24 inches. Only the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

(2) As shown in Table 620-17, the soil properties and qualities that affect the absorption of the effluent are permeability, depth to a seasonal high water table, depth to bedrock, depth to a cemented pan, and susceptibility to flooding. Stones and boulders and a shallow depth to bedrock, ice, or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion is a hazard where absorption fields are installed in sloping soils.

(3) Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new; as a result, the ground water supply may be contaminated. Soils that have a hazard of inadequate filtration are given a severe rating.

(4) Percolation tests are used by some regulatory agencies to evaluate the suitability of a soil for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity. The percolation rates do not correspond to the permeability rates because they are measured by different methods. Experience indicates that soils that have a percolation rate faster than 45 minutes per inch function satisfactorily, soils that have a rate between 45 and 60 minutes per inch have moderate limitations, and soils that have a rate slower than 60 minutes per inch have severe limitations.[1/]

(5) In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.[2/] However, such systems are not considered in this guide.

[1/] U.S. Department of Health, Education and Welfare, Public Health Service, 1969 Manual of Septic Tanks, PHS Publication No. 526, p. 8.

[2/] Bouma, J. 1974. New Concepts in Soil Survey Interpretations for Onsite Disposal of Septic Tank Effluent.

Table 620-17 Septic Tank Absorption Fields.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	TOTAL SUBSIDENCE (IN)	---	---	>24	SUBSIDES
3.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
4.	DEPTH TO BEDROCK (IN)	>72	40-72	<40	DEPTH TO ROCK
5.	DEPTH TO CEMENTED PAN (IN)	>72	40-72	<40	CEMENTED PAN
6.	PONDING	---	---	+	PONDING
7.	DEPTH TO HIGH WATER TABLE (FT)	>6	4-6	<4	WETNESS
8.	PERMEABILITY (24-60", IN/H)	2.0-6.0	0.6-2.0	<0.6	PERCS SLOWLY
8a.	PERMEABILITY (24-60", IN/H)	---	---	>6.0	POOR FILTER
9.	SLOPE (PCT)	<8	8-15	>15	SLOPE
10.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 40")	<25	25-50	>50	LARGE STONES

(c) Sewage lagoons.

(1) Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the wastes. Lagoons have a nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Relatively impervious soil for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

(2) The properties, qualities, limits, and restrictive features used in rating soils for sewage lagoons are listed in Table 620-18. Soil permeability is a critical property in evaluating a soil for sewage lagoons. Most porous soils will eventually seal when being used for a sewage lagoon. Until they do, however, the hazard of pollution is severe. Soils that have a permeability rate that exceeds 2 inches per hour generally are too porous for the proper operation of sewage lagoons and may cause contamination. Fractured bedrock within a depth of 40 inches may create a pollution hazard. Bedrock and cemented pans create construction problems.

(3) Slope must be gentle enough and the soil material must be thick enough over bedrock or a cemented pan to make smoothing practical so that the lagoon is uniformly deep throughout.

(4) If floodwater overtops the lagoon, it interferes with the functioning of the lagoon and carries away polluting sewage before sufficient decomposition has taken place. Ordinarily, soils susceptible to flooding have a severe limitation for sewage lagoons. If floodwater velocities are slow and flooding is rarely deep enough to overtop the lagoon embankment, the susceptibility to flooding does not constitute a severe limitation rating.

(5) Soils that contain a large amount of organic matter are not suitable for the floor of an aerobic lagoon. The organic matter promotes an anaerobic rather than aerobic environment.

(6) Depth to water table is important if it influences the water level in the lagoon. If it does, a pollution hazard exists. Sometimes depth to water table is disregarded if the lagoon floor is of slowly permeable soil material that is at least 4 feet thick. Soils that contain excess rock fragments greater than 3 inches are undesirable sites because the fragments interfere with the manipulation and compaction needed to prepare the lagoon floor.

Table 620-18 Sewage Lagoons.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	PERMEABILITY (IN/H) (12-60")	<0.6	0.6-2.0	>2.0	SEEPAGE
3.	DEPTH TO BEDROCK HARD (IN)	>60	40-60	<40	DEPTH TO ROCK
3a.	DEPTH TO BEDROCK SOFT (IN)	>60	40-60	<40	DEPTH TO ROCK
4.	DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
5.	FLOODING (HIGH VELOCITY OR >5 FEET HIGH)	NONE, RARE	---	OCCAS, FREQ	FLOODING
6.	SLOPE (PCT)	<2	2-7	>7	SLOPE
7.	UNIFIED (ANY DEPTH)	---	OL, OH	PT	EXCESS HUMUS
8.	PONDING	---	---	+	PONDING
9.	DEPTH TO HIGH WATER TABLE (FT) (IF NO LAYER >20" THICK WITH PERM. <.2"/H)	>5	3.5-5	<3.5	WETNESS
10.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 20")	<20	20-35	>35	LARGE STONES

(d) Sanitary landfill (trench).

(1) Sanitary landfill (trench) is a method of disposing solid waste by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill.

(2) Ratings are based on properties and qualities to the depth normally observed during soil mapping (approximately 5 or 6 feet). However, because trenches may be as deep as 15 feet or more, geologic investigations are needed to determine the potential for pollution of ground water as well as to determine the design needed. These investigations, which are generally arranged by the landfill developer, include the examination of stratification, rock formations, and geologic conditions that might lead to the conducting of leachates to aquifers, wells, water courses, and other water sources. The presence of hard, nonrippable bedrock, creviced bedrock, or highly permeable strata in or immediately underlying the proposed trench bottom is undesirable because of the difficulty in excavation and the potential pollution of underground water.

(3) Soil properties and qualities used in ratings for sanitary landfill (trench) are listed in Table 620-19. Properties that influence the risk of pollution, ease of excavation, trafficability, and revegetation are major considerations. Soils that flood or have a water table within the depth of excavation present a potential pollution hazard and are difficult to excavate.

(4) Slope is an important consideration because it affects the work involved in road construction, the performance of the roads, and the control of surface water around the landfill. It may also cause difficulty in constructing trenches for which the trench bottom must be kept level and oriented to follow the contour.

(5) The ease with which the trench is dug and with which a soil can be used as daily and final cover is based largely on texture and consistence of the soil. The texture and consistence of a soil determine the degree of workability of the soil both when dry and when wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and difficult to place as a uniformly thick cover over a layer of refuse.

(6) The uppermost part of the final cover should be soil material that is favorable for the growth of plants. It should not contain excess sodium or salt and should not be too acid. In comparison with other horizons, the A horizon in most soils has the best workability and the highest content of organic matter. Thus, for a trench-type landfill operation it may be desirable to stockpile the surface layer for use in the final blanketing of the fill.

Table 620-19 Sanitary Landfill (Trench).

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
2.	DEPTH TO BEDROCK HARD (IN)	---	---	<72	DEPTH TO ROCK
2a.	DEPTH TO BEDROCK SOFT (IN)	---	---	<72	DEPTH TO ROCK
3.	DEPTH TO CEMENTED PAN THICK (IN)	---	<72	---	CEMENTED PAN
3a.	DEPTH TO CEMENTED PAN THIN (IN)	---	---	<72	CEMENTED PAN
4.	PERMEABILITY (IN/H, BOTTOM LAYER)	---	---	>2.0	SEEPAGE
4a.	PERMEABILITY (IN/H, BOTTOM LAYER; IF ARIDISOL AND NOT SALORTHID OR AQUIC SUBGROUPS, ALL ARIDIC SUBGROUPS, ALL TORRIC GREAT GROUPS EXCEPT AQUIC SUBGROUPS)	ANY ENTRY	---		SEEPAGE
5.	PONDING	---	---	+	PONDING
6.	DEPTH TO HIGH WATER TABLE APPARENT (FT)	---	---	<6	WETNESS
6a.	DEPTH TO HIGH WATER TABLE PERCHED (FT)	>4	2-4	<2	WETNESS
7.	SLOPE PERCENT	<8	8-15	>15	SLOPE
8.	USDA TEXTURE	---	---	ICE	PERMAFROST
8a.	TEXTURE (THICKEST LAYER 10-72"; FOR NON ARIDISOL, ARID SUBGROUPS, & TOR GREAT GROUPS)	---	CL, SC, SICL	SIC, C	TOO CLAYEY
8b.	TEXTURE (THICKEST LAYER 10-72" KAOLINITIC MIN.)	---	SIC, C	---	TOO CLAYEY

Table 620-19 Sanitary Landfill (Trench)(continued).

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
8c.	TEXTURE (THICKEST LAYER 10-72")	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS, SG	TOO SANDY
9.	UNIFIED (THICKEST LAYER 10-72")	---	---	OL, OH, PT	EXCESS HUMUS
10.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 72")	<20	20-35	>35	LARGE STONES
11.	SODIUM ADSORPTION RATIO (NON ARIDISOLS, ARIDIC, AND TORRIC SUBGROUPS	---	---	>13	EXCESS SODIUM
12.	SOIL REACTION (pH, ANY DEPTH)	---	---	<3.5	TOO ACID
13.	SALINITY (MMHOS/CM, ANY DEPTH)	---	---	>16	EXCESS SALT

(e) Sanitary landfill (area).

(1) Sanitary landfill (area) is a method of disposing solid waste by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Properties and qualities that influence trafficability and risk of pollution are the important considerations for area sanitary landfills.

(2) In Table 620-20, the properties and qualities considered for rating soils for sanitary landfill (area) are listed. Flooding is a serious problem because of the risk of washouts and pollution downstream and the difficulty of moving trucks in and out of flooded areas.

(3) Permeability of the soil is an important consideration in all but the most arid parts of the country. If permeability is too rapid or if fractured bedrock or a fractured cemented pan is close to the surface, the risk of contaminating the water supply by leachate is great. A high water table may also transmit pollutants to the water supply and is likely to restrict truck movement during wet seasons.

(4) Slope is a consideration because of the extra grading required to maintain roads on sloping soils. Furthermore, leachate may flow along the soil surface on sloping soils and cause difficult seepage problems in completed fills.

Table 620-20 Sanitary Landfill (Area).

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	FLOODING	NONE	RARE	FREQ, OCCAS	FLOODING
3.	DEPTH TO BEDROCK (IN) (FOR NON ARIDISOLS & ARIDIC SUBGROUPS)	>60	40-60	<40	DEPTH TO ROCK
4.	DEPTH TO CEMENTED PAN (IN) (FOR NON ARIDISOLS & ARIDIC SUBGROUPS)	>60	40-60	<40	CEMENTED PAN
5.	PERMEABILITY (IN/H, 20-40") (FOR NON ARIDISOLS & ARIDIC SUBGROUPS)	---	---	>2.0	SEEPAGE
6.	PONDING	---	---	+	PONDING
7.	DEPTH TO HIGH WATER TABLE APPARENT (FT)	>5	3.5-5	<3.5	WETNESS
7a.	DEPTH TO HIGH WATER TABLE PERCHED (FT)	>3	1.5-3	<1.5	WETNESS
8.	SLOPE (PCT)	<8	8-15	>15	SLOPE

(f) Daily cover for landfill.

(1) Daily cover for landfill is the soil material that is applied daily to compacted solid waste in an area sanitary landfill. The cover material is obtained offsite, transported, and spread on the area. The required soil characteristics for both daily and final cover material are similar enough to share one rating.

(2) The properties and qualities used to determine the suitability of soil material for daily cover landfills are listed in Table 620-21. Suitability of a soil for use as cover is based on properties that reflect workability and the ease of digging and of moving and spreading the material over the refuse daily during both wet and dry periods. Soils that are loamy or silty and that are free of stones are better suited than other soils. Clayey soils may be sticky and difficult to spread, and sandy soils may be subject to soil blowing.

(3) The soil must be thick enough over bedrock, a cemented pan, or the water table so that material can be removed efficiently while leaving a borrow area that can be revegetated. Some damage to the borrow area is expected; but if revegetation and erosion are serious problems, then the soil is rated severe.

(4) Slope affects the ease of excavation and of moving the cover material. It also may affect the final configuration of the borrow area and, thus, runoff, erosion, and reclamation.

(5) In addition to these features, the soils selected for daily cover for landfill should be suitable for growing plants. They should not contain significant amounts of substances that are toxic to plants, such as a high content of sodium, salts, or lime.

Table 620-21 Daily Cover for Landfill.

	PROPERTY	LIMITS: SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	DEPTH TO BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
3.	DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
4.	UNIFIED (THICKEST LAYER 10-60")	---	---	SP, SW, SP-SM, SW-SM, GP, GW, GP-GM, GW-GM	SEEPAGE
5.	TEXTURE (THICKEST LAYER 10-60")	---	CL, SICL, SC	SIC, C	TOO CLAYEY
5a.	TEXTURE (THICKEST LAYER 10-60" KAOLINITIC)	CL, SICL, SC	SIC, C	---	TOO CLAYEY
6.	TEXTURE (THICKEST LAYER 10-60")	---	LCOS, LS, LFS, VFS	S, FS, COS, SG	TOO SANDY
7.	UNIFIED (THICKEST LAYER 10-60")	---	---	OL, OH, CH, MH	HARD TO PACK
7a.	UNIFIED (THICKEST LAYER 10-60" KAOLINITIC)	---	OL, OH, CH, MH	---	HARD TO PACK
8.	WEIGHT PERCENT 2mm-3" (WEIGHTED TO 60")	<25	25-50	>50	SMALL STONES
8a.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 60")	<25	25-50	>50	LARGE STONES
9.	SLOPE (PCT)	<8	8-15	>15	SLOPE
10.	PONDING	---	---	+	PONDING
11.	DEPTH TO HIGH WATER TABLE (FT)	>3.5	1.5-3.5	<1.5	WETNESS
12.	UNIFIED (THICKEST LAYER 10-60")	---	---	PT	EXCESS HUMUS
13.	SOIL REACTION (pH, 10-60")	---	---	<3.5	TOO ACID
14.	SALINITY (MMHOS/CM; 10-60") (FOR NON ARIDISOLS AND ARIDIC SUBGROUPS)	---	---	>16	EXCESS SALT

Table 620-21 Daily Cover for Landfill (continued).

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
15.	SODIUM ADSORPTION RATIO (10-60")	---	---	>13	EXCESS SODIUM
16.	CALCIUM CARBONATE EQ (PCT) (THICKEST LAYER 10-60")	---	---	>40	EXCESS LIME
17.	LAYER THICKNESS	>60	40-60	<40	THIN LAYER

620.09 Waste Management.

(a) General.

(1) Soil interpretations for waste management provide a means to use organic wastes and waste-water as productive resources. Using these resources will result in energy conservation, prevent waste, and minimize problems associated with their disposal. The planned use of many wastes has proven beneficial to the producer and the user of these by-products. The characteristics of the soil are important in the application of organic wastes and wastewater to land for fertilization and irrigation. They are also important considerations if the soil is used as a medium for the treatment and disposal of these wastes. Favorable soil properties are required to prevent environmental damage.

(2) The interpretation guides for wastewater includes municipal and food processing wastewater and lagoon or storage pond effluent. Manure, food processing waste, and municipal sludge may be liquid; however, for the purposes of these guides, they are not considered to be wastewater unless the water content is more limiting to the rate of application than the nutrient or biochemical oxygen demand (BOD) content. The rating are for each soil in its present condition and do not consider present land use. The suitability ratings provided for each interpretation are based on the influence of existing soil properties on the use. For each soil rated, the degree of suitability and the most restrictive features that affect the proposed use are identified. The restrictive features are identified for each moderate or severe suitability rating as it affects use and performance for the desired purpose. Thus the user can develop alternatives for use and management.

(3) These guides are designed for the management of defined classes of organic wastes and wastewater, whether or not the objective is treatment for utilization by a crop[1/] (as with manure and food processing wastes, municipal sewage sludge, and wastewater used for irrigation); treatment without regard to crop needs (such as treatment of water by the slow process, treatment of water by the overland flow process, and treatment of water by the rapid infiltration process); or land reclamation (as with carbonaceous materials used as a soil conditioner and stabilizer). Not considered in these guides, but important in evaluating a site, are allocation and accessibility of the area, size and shape of the area, and use and management of the treatment area. Geology, hydrology, and climate are considered only to the extent that they are reflected in the kind of soil mapped. Waste quality and rate of application are considered to the extent that they are within the "safe" limits as recommended in such publications as Application of Sewage Sludge of Cropland--Appraisal of Potential Hazards of the Heavy Metals to Plants and Animals, November 1976, MCD-33, EPA 430/9-76-013; Municipal Sludge Management--Environmental Factors, October 1977, MCA-28, EPA 430/9-77-044; Criteria for Classification of Solid Waste Disposal Facilities and Practices, EPA, in Federal Register, Vol. 44, No. 179, September 13, 1979, pp. 53460-53464; and Process Design Manual for Land Treatment of Municipal Wastewater, October 1977, EPA 625/1-77-008, or within the regulatory guidelines adopted by the individual state(s) if the state regulation is more restrictive.

(4) This section contains guides for interpreting soils for use in the management of manure and food processing wastes; the management of municipal sewage sludge; the

management of wastewater used for irrigation; the treatment of wastewater by the slow rate process; the treatment of wastewater by the overland flow process; the treatment of wastewater by the rapid infiltration process; and the management of carbonaceous material as a soil conditioner and stabilizer. Wastewater includes municipal and food processing wastewater and lagoon or storage pond effluent. Manure, food processing waste, and municipal sludge may be liquid; however, for the purpose of these guides they are not considered to be wastewater unless the water content is more limiting the to rate of application than the nutrient or biochemical oxygen demand content.

(b) Land application of manure and food processing waste.

(1) Manure is the excrement of livestock and poultry. The consistency of manure is labile. It changes in storage or treatment, and it depends upon the bedding used and upon whether the manure is diluted or allowed to dry. Food processing wastes consist of damaged fruit and vegetables and the peelings, stems, leaves, pits, and soil particles removed in food preparation. Most wastes produced in the processing of milk, cheese, and meat are liquids. Paunch manure is an exception.

(2) Manure and food processing wastes have a variable nitrogen content. The material is either solid, slurry, or liquid. A high nitrogen content limits the application rate. Toxic or otherwise dangerous wastes, such as those mixed with the lye used in food processing, are outside the meaning of manure and food processing wastes as used in this guide.

(3) As shown in Table 620-22, the soil properties and qualities considered are those that affect soil absorption, plant growth, microbial activity, the susceptibility to wind or water erosion, and the rate and method of the application of wastes. Soil properties that affect absorption are permeability, the depth to a seasonal high water table, sodium adsorption ratio, the depth to bedrock or a cemented pan, and the available water capacity. Soil reaction, sodium adsorption ratio, salinity, and bulk density are soil properties that affect plant growth and microbial activity.

1/ The type of crop that can be grown and its utilization for human or animal consumption may be specified by local, state, or county health regulations.

The wind erodibility group, erosion factor, slope, and susceptibility to flooding are used to measure the potential for wind and water erosion. Stones and the depth to a seasonal high water table can interfere with the application of wastes. Permanently frozen soils are not suited to the treatment of wastes.

(4) The soil rating guide is based on utilizing the nutrients in the wastes for crop production and is not directed toward reclaiming or restoring critical areas or making the most efficient use of moisture. Applications of liquid wastes can be made by tank wagon or conventional irrigation methods that are modified as necessary to function properly. Applications of solid and slurry wastes can be made at the surface or subsurface.

Table 620-22 Land Application of Manure and Food Processing Waste.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	PERMEABILITY (0-60", IN/H)	---	2.0-6.0	>6	POOR FILTER
2a.	PERMEABILITY (0-60", IN/H)	.6-2.0	.2-.6	<.2	PERCS SLOWLY
3.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
4.	PONDING	---	---	+	PONDING
5.	SLOPE (PCT)	<6	6-15	>15	SLOPE
6.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
7.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
8.	SODIUM ADSORPTION RATIO (0-20")	<4	4-13	>13	EXCESS SODIUM
9.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
10.	FLOODING	NONE	RARE	OCCAS, FREQ	FLOODING
11.	CLAY ACTIVITY (CEC/CLAY)	>.15	.05-.15	<.05	LOW ADSORPTION
12.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
13a.	WEIGHT PERCENT 3-10" (SURFACE LAYER)	<15	15-35	>35	TOO COBBLY
13b.	WEIGHT PERCENT >10" (SURFACE LAYER)	<5	5-15	>15	TOO STONY
14.	AVAILABLE WATER (WEIGHT AV., 0 TO 60")	>6	3-6	<3	DROUGHTY
15.	SOIL REACTION (pH, SURFACE LAYER)	>6.0	5.0-6.0	<5.0	TOO ACID

(c) Land application of municipal sewage sludge.

(1) Municipal sewage sludge as used in this guide is the residual product of the treatment of municipal sewage. The solid component is composed mainly of cell mass, primarily bacteria cells which have developed during secondary treatment and which have incorporated soluble organics into their own bodies. Sludge also contains small amounts of sand, silt, and other solid debris.

(2) Municipal sewage sludges have a variable nitrogen content. Some sludge contains constituents that are toxic to plant growth or hazardous to the food chain (such as heavy metals or exotic organic compounds) and should be chemically analyzed prior to use.

(3) The water content of sludge ranges from about 98 percent to about 40 percent or less. The sludge is called liquid if it is more than about 90 percent water, slurry if it is about 90 to 50 percent water, and solid if it is less than about 50 percent water. Depending on the water content, the sludge can be moved by pump, conveyor, or auger.

(4) As shown in Table 620-23, the soil properties and qualities considered in rating the degree of limitation are those that affect soil absorption, plant growth, microbial activity, the susceptibility to wind or water erosion, and the rate and method of application. Soil properties and qualities that affect absorption are permeability, the depth to a seasonal high water table, soil reaction, sodium adsorption ratio, salinity, and bulk density. They also affect plant growth and microbial activity. Slope and the susceptibility to flooding are used to measure the potential for water erosion. Stones and the depth to a seasonal high water table can interfere with the application of wastes. Permanently frozen soils are not suited to the treatment of wastes.

(5) The soil rating guide is based on utilizing the nutrients in the waste for crop production and is not directed toward reclaiming or restoring critical areas or making the most efficient use of moisture. Applications of slurry sludge can be by tank wagon or by irrigation equipment that is modified as necessary to function properly. Applications of solid and slurry sludges can be made at the surface or subsurface.

Table 620-23 Land Application of Municipal Sewage Sludge.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	PERMEABILITY (0-60", IN/H)	---	2.0-6.0	>6.0	POOR FILTER
2a.	PERMEABILITY (0-60", IN/H)	.6-2.0	.2-.6	<.2	PERCS SLOWLY
3.	PONDING	---	---	+	PONDING
4.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
5.	SLOPE (PCT)	<8	8-15	>15	SLOPE
6.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
7.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
8.	SODIUM ADSORPTION RATIO (0-20")	<4	4-13	>13	EXCESS SODIUM
9.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
10.	FLOODING	NONE	RARE	OCCAS, FREQ	FLOODING
11.	CLAY ACTIVITY (CEC/CLAY; 0-20")	>.15	.05-.15	<.05	LOW ADSORPTION
12.	AVAILABLE WATER (WEIGHTED AV. 0-60", IN)	>6	3-6	<3	DROUGHTY
13.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
14.	WEIGHT PERCENT 3-10" (SURFACE LAYER)	<15	15-35	>35	TOO COBBLY
14a.	WEIGHT PERCENT >10" (SURFACE LAYER)	<5	5-15	>15	TOO STONY
15.	SOIL REACTION (pH, SURFACE LAYER)	>6.5	5.0-6.5	<5.0	TOO ACID

(d) Disposal of wastewater by irrigation.

(1) The wastewater considered in this guide is municipal wastewater and wastewater from food processing plants, lagoons, and storage ponds. Municipal wastewater is the water in the waste stream from a municipality. It contains domestic waste and, in some areas, includes industrial waste. It may be untreated, although this is rare, or it may be wastewater that has received primary or secondary treatment. Food processing wastewater is the wastewater resulting from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In some places it has a high content of sodium and chloride. Lagoon and storage pond effluent, as discussed in this guide, refer to the effluent from facilities used to treat or store domestic wastes, wastewater from food processing, or liquid animal wastes. The effluent from a municipal or food processing plant lagoon or storage pond commonly is very low in carbonaceous and nitrogenous matter. The nitrogen content ranges from 10 to 30 mg/l. The effluent from animal waste treatment lagoons or storage ponds have much higher concentrations of these materials mainly because the manure has not been diluted as much as domestic wastes. The nitrogen content varies considerably but generally is from 50 to 2,000 mg/l.

(2) Some wastewater may cause an increase in sodicity or salinity in the soils in arid and semiarid regions but it generally does not in humid regions. The heavy metal contents of effluents are usually low; however, chemical analyses should be made prior to use.

(3) The soil properties and qualities that are listed in Table 620-24 need to be considered in the design, construction, management, and performance of wastewater irrigation systems. The soil properties and qualities important in design and management are the sodium adsorption ratio, depth to a seasonal high water table, the available water capacity, permeability, wind erodibility, erosion factor, slope, and flooding. The soil properties and qualities that influence construction are stones, depth to bedrock or to a cemented pan, and depth to a seasonal high water table. The properties and qualities that affect performance of the irrigation system are depth to bedrock or to a cemented pan, bulk density, the sodium adsorption ratio, salinity, and soil reaction. The cation exchange capacity also affects performance, and it is used here as an estimate of the capacity of a soil to adsorb heavy metals. Permanently frozen soils are not suited to irrigation.

(4) The soil rating guide is based on the utilization of the water for crop production and is not directed toward only the disposal or treatment of the wastewater. Checks should be made to ensure that heavy metals, nitrogen, and other salts are not added in excessive amounts.

Table 620-24 Disposal of Wastewater By Irrigation.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	SODIUM ADSORPTION RATIO	<4	4-13	>13	EXCESS SODIUM
3.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
4.	SLOPE (SURFACE, PCT)	<3	3-8	>8	SLOPE
4a.	SLOPE (SPRINKLER, PCT)	<6	6-15	>15	SLOPE
5.	PONDING	---	---	+	PONDING
6.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
7.	DEPTH TO BEDROCK (IN)	>40	20-40	<20	DEPTH TO ROCK
8.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	CEMENTED PAN
9.	PERMEABILITY (IN/H)	---	2.0-6.0	>6.0	POOR FILTER
9a.	PERMEABILITY (0-60", IN/H)	0.6-2.0	0.2-0.6	<0.2	PERCS SLOWLY
10.	AVAILABLE WATER (WEIGHTED AV. TO 60", IN)	>6	3-6	<3	DROUGHTY
11.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
12.	WEIGHT PERCENT 3-10" (SURFACE LAYER)	<15	15-35	>35	TOO COBBLY
12a.	WEIGHT PERCENT >10" (SURFACE LAYER)	<5	5-15	>15	TOO STONY
13.	FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
14.	SOIL REACTION (pH)	>6.5	5.0-6.5	<5.0	TOO ACID
15.	CLAY ACTIVITY (CEC/CLAY)	>.15	.05-.15	<.05	LOW ADSORPTION

(e) Treatment of wastewater by the slow rate process.

(1) In this process wastewater is applied to the land at a rate normally between 0.5 and 4.0 inches per week. The primary purpose is wastewater treatment rather than irrigation of crops. Application rates commonly exceed those needed for supplemental irrigation for crop production. The applied wastewater is treated as it moves through the soil. Much of the treated water percolates to the ground water, and some enters the atmosphere by evapotranspiration. Surface runoff of the applied water generally is not allowed. Waterlogging is avoided either through control of the application rate or the use of tile drains, or both.

(2) The wastewater considered includes municipal wastewater and effluent from food-processing plants, lagoons, and storage ponds.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and possibly industrial waste. It may be, although rarely is, untreated sewage or may be wastewater that has received primary or secondary treatment. Food-processing wastewater is the wastewater resulting from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In some places it is high in sodium and chloride. Lagoon and storage pond effluents, as discussed here, refer to the effluents from a facility used to treat or store food-processing wastewater, domestic wastes, or animal wastes. Domestic and food-processing wastewater is very dilute, and the effluent from facilities that treat or store it commonly is very low in carbonaceous and nitrogenous matter. The nitrogen content ranges from 10 to 30 mg/l. Lagoons or storage ponds for animal wastes have an effluent that has a much higher concentration of these materials mainly because the manure has not been diluted as much as domestic wastes. The nitrogen content varies considerably but generally is 50 to 2,000 mg/l. The heavy metal content generally is low; however, chemical analyses should be made prior to use.

(3) As shown in Table 620-25, the soil properties and qualities considered in rating the degree of limitation are those that affect soil absorption, plant growth, microbial activity, the susceptibility to wind or water erosion, and the application of wastes. Properties and qualities that affect absorption are the sodium adsorption ratio, depth to a seasonal high water table, the available water capacity, permeability, depth to bedrock or to a cemented pan, soil reaction, cation exchange capacity, and slope. Soil reaction, the sodium adsorption ratio, salinity, and bulk density are soil properties that affect plant growth and microbial activity. Wind erodibility group, erosion factor, slope, and susceptibility to flooding are used to measure the potential for wind erosion and water erosion. Stones can interfere with the application of wastes. Permanently frozen soils are not suited to treating wastewater.

(4) The soil rating guide is based on the treatment of the wastewater and is not directed toward the use of water as a source of moisture for crop production. However, it is assumed that crops are grown or may be grown as a part of the soil-plant treatment process. Checks should be made to ensure that heavy metals and nitrogen are not added in excessive amounts.

Table 620-25 Treatment of Wastewater by the Slow Rate Process.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	SODIUM ADSORPTION RATIO (0-20")	<4	4-13	>13	EXCESS SODIUM
3.	SALINITY (SURFACE LAYER, MMHOS/CM)	<4	4-8	>8	EXCESS SALT
4.	SLOPE PERCENT (SURFACE)	<3	3-8	>8	SLOPE
4a.	SLOPE PERCENT (SPRINKLER)	<6	6-12	>12	SLOPE
5.	PONDING	---	---	+	PONDING
6.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
7.	PERMEABILITY (0-60", IN/H)	0.6-2.0	2.0-6.0	>6.0	POOR FILTER
7a.	PERMEABILITY (0-60", IN/H)	---	0.06-0.6	<0.06	PERCS SLOWLY
8.	DEPTH TO BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
9.	DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
10.	FLOODING	NONE, RARE	OCCAS.	FREQ	FLOODING
11.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
12.	WEIGHT PERCENT 3-10" (SURFACE LAYER)	<15	15-35	>35	TOO COBBLY
13.	WEIGHT PERCENT >10" (SURFACE LAYER)	<5	5-15	>15	TOO STONY
14.	SOIL REACTION (pH)	>6.5	5.0-6.5	<5.0	TOO ACID
15.	CLAY ACTIVITY (CEC/CLAY)	>.15	.05-.15	<.05	LOW ADSORPTION

(f) Treatment of wastewater by the overland flow process.

(1) In this process wastewater is applied to the upper reaches of sloped land and allowed to flow across vegetated surfaces which are sometimes called terraces, to runoff collection ditches. The length of the run generally is 150 to 300 feet. Application rates range from 2.5 to 16.0 inches per week. The wastewater leaves solids and nutrients to plants and soil surfaces as it flows downslope in a thin film. Most of the water reaches the collection ditch, some is lost by evapotranspiration, and a small part percolates to the ground water.

(2) The wastewater considered is from municipal wastewater, food-processing plants, lagoons, and storage ponds. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and possibly industrial waste. It may be, although rarely is, raw sewage (untreated), or it may be wastewater that has received primary or secondary treatment. Food-processing wastewater is the wastewater resulting from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In some places it is high in sodium and chloride. Lagoon and storage pond effluents, as discussed here, refer to the effluents from a lagoon or storage pond that is used to treat or store food-processing wastewater, domestic wastes, or animal wastes. Domestic wastes are very dilute, and the effluent from a facility that treats them commonly is very low in carbonaceous and nitrogenous matter. The nitrogen content ranges from 10 to 30 mg/l. Lagoons and storage ponds that treat animal wastes have an effluent that has a much higher concentration of these materials mainly because the manure has not been diluted as much as domestic wastes. The nitrogen content varies considerably but generally is 50 to 2,000 mg/l. The heavy metal content generally is low; however, chemical analyses should be made prior to use.

(3) As shown in Table 620-26 the soil properties and qualities considered in rating the degree of limitation are those that affect absorption, plant growth, microbial activity, and the design and construction of site. The properties that affect adsorption are soil reaction and the cation exchange capacity. Soil reaction, salinity, and the sodium adsorption ratio are soil properties that affect plant growth and microbial activity. Slope, permeability within a depth of about 30 inches, depth to a seasonal high water table, flooding, depth to bedrock or to a cemented pan, and stones are soil properties and qualities that influence design and construction. Permanently frozen soils are not suited to treating wastewater.

(4) The soil rating guide is based on the treatment of the wastewater and is not directed toward the use of the water as a source of moisture for crop production. However, areas are vegetated because plants are a necessary part of the soil-plant treatment process. Wastewater generally is applied by sprinkler or surface application methods.

Table 620-26 Treatment of Wastewater by the Overland Flow Process.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	SLOPE (PCT)	1-6	6-12	>12	SLOPE
2a.	SLOPE (PCT)	---	.5-1	<.5	SLOPE
3.	PERMEABILITY (SURFACE LAYER, IN/H)	<0.2	.2-.6	>.6	SEEPAGE
4.	DEPTH TO BEDROCK (IN)	>60	40-60	<40	DEPTH TO ROCK
5.	PONDING	---	---	+	PONDING
6.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
7.	FLOODING	NONE	RARE	OCCAS, FREQ	FLOODING
8.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
9.	WEIGHT PERCENT 3-10" (WEIGHTED AV. 0-40")	<15	15-35	>35	TOO COBBLY
9a.	WEIGHT PERCENT >10"(WEIGHTED AV. 0-40")	<5	5-15	>15	TOO STONY
10.	SOIL REACTION (pH, SURFACE LAYER)	>6.5	5.0-6.5	<5.0	TOO ACID
11.	DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
12.	SODIUM ADSORPTION RATIO (0-20")	<4	4-13	>13	EXCESS SODIUM
13.	SALINITY (SURFACE LAYER, MMHOS/CM)	<8	8-16	>16	EXCESS SALT
14.	CLAY ACTIVITY (CEC/CLAY)	>.15	.05-.15	<.05	LOW ADSORPTION

(g) Treatment of wastewater by the rapid infiltration process.

(1) In this process the wastewater is applied in a level basin and percolates through the soil. The treated water eventually reaches the ground water. Application rates range from 4 to 120 inches per week.

(2) Because the thickness of soil material needed for proper renovation of the wastewater is more than 72 inches, geologic and hydrologic investigations during the planning stages are needed to ensure proper design and to determine reliability of performance as well as the potential for pollution of the ground water.

(3) The wastewater considered generally is from municipal wastewater treatment plants. The nitrogen content generally is low. Normally, the heavy metal content is low; however, chemical analysis should be made prior to use.

(4) The soil properties and qualities that influence risk of pollution, design and construction, and performance are major considerations. They are listed in Table 620-27. Depth to a seasonal high water table, flooding, and depth to bedrock or to a cemented pan present potential hazards and influence design and construction. Slope and stones are also important considerations in design and construction. The properties and qualities that influence performance are permeability and soil reaction. Permanently frozen soils are not suited to treating wastewater.

(5) The soil rating guide is based on the treatment of the wastewater and is not directed toward the use of the water as a source of moisture for crop production. Vegetation is not a necessary part of the treatment process; hence, the basins may or may not be vegetated.

Table 620-27 Treatment of Wastewater by the Rapid Infiltration Process.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	SLOPE (PCT)	<4	4-8	>8	SLOPE
3.	PERMEABILITY (0-72", IN/H)	>6	2.0-6.0	<2.0	PERCS SLOWLY
4.	PONDING	---	---	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (FT)	---	---	<6	WETNESS
6.	FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
7.	DEPTH TO BEDROCK (IN)	---	---	<72	DEPTH TO ROCK
8.	DEPTH TO CEMENTED PAN (IN)	---	---	<72	CEMENTED PAN
9.	STONINESS CLASS	1	2	3, 4, 5	TOO STONY
10.	WEIGHT PERCENT 3-10" (WEIGHTED AV. TO 72")	<15	15-35	>35	TOO COBBLY
10a.	WEIGHT PERCENT >10" (WEIGHTED AV. TO 72")	<5	5-15	>15	TOO STONY
11.	SOIL REACTION (pH, 10-72")	>5	3.5-5	<3.5	TOO ACID

(h) Carbonaceous materials used as a soil conditioner and stabilizer.

(1) These materials include wood-processing wastes, leaves, straw, stover, some paper products, manure, and municipal sewage sludge. Except for manure and sewage sludge, they generally are very low in nitrogen. These wastes are solid, and some can be spread by using blowers.

(2) A soil interpretation rating guide has not been prepared for rating soils for the utilization of these materials as a soil conditioner or stabilizer.

(3) The carbonaceous materials can be used as a mulch or soil conditioner to stabilize critical areas, in land reclamation, or in landscaping. Practices are needed to prevent removal of the material from the site by wind or water erosion. If municipal sewage sludge is used on land that will be used for the production of food-chain crops, it is important that the maximum lifetime site application of sludge-borne metals does not exceed that specified in Municipal Sludge Management: Environmental Factors, October 1977, MCD-28, EPA 430/9-77-044, pp. 18-22, or does not exceed the regulatory guidelines adopted by the Federal Government (Criteria for Classifications of Solid Waste Disposal Facilities and Practices, EPA, in Federal Register, Vol. 44, No. 179, September 13, 1979, pp. 53460-53464) or by the individual state(s), if the state regulation is more restrictive.

(4) Soils vary widely in the extent to which their tilth can be improved by the addition of organic materials. In general, more benefits are gained by applying organic materials to:

- -- Soils that are low in organic matter;
- -- Sandy soils, in order to improve the available water capacity and reduce soil erosion;
- -- Clayey soils, in order to improve tilth, reduce cloddiness, and reduce the energy required in tillage; and
- -- Silty and sandy soils that have a very low content of clay, in order to reduce soil compaction.

(5) If the organic waste is very low in nitrogen, less than about 1.2 percent dry weight, its decomposition in the soil commonly results in the tie-up of soil nitrogen in a form that makes it unavailable to plants for a period of several months. This tie-up is caused by the competition between soil microflora and the plants for the nitrogen present. If plants are to be grown, additional nitrogen generally is needed to raise the average nitrogen content of the organic material from 1.2 to 1.5 percent dry weight or more. Thus, more additions of nitrogen are required than if the organic material had not been applied.

620.10 Water Management.

(a) General.

(1) Soil survey interpretations are developed for use in evaluating the potential of the soil in the application of various water management practices. This application may involve the movement of water to or from a site, holding water on a site, or securing a water source. The interpretation guides are applicable to both heavily and sparsely populated areas. Ratings are for the soils are rated in their present condition and do not consider present land use. Soil limitation ratings and associated restrictive features are given for ponds and reservoir areas; embankments, dikes, and levees; and excavated ponds. If a soil is rated as having moderate or severe limitations for these uses, changes need to be made to the original design to overcome the restricting soil properties or a more suitable site should be selected. Soils that have slight limitations are favorable for the rated use.

(2) Only restrictive features are given for drainage, irrigation, terraces and diversions, and grassed waterways because these uses are not rated. Any restrictions in use will ultimately affect design, layout, construction, management, and performance. The impact on the rehabilitation and growth of vegetation, which minimizes water erosion, is an important consideration for many of these interpretations.

(3) Some soil surveys are moderate or low in intensity or are more general. These surveys are helpful in the evaluation of alternative sites; however, onsite investigations are required to design projects. The interpretations for water management may appear to be useful only in agricultural development, but they have potential for broader application. Use of these guides helps to meet various planning needs including building site development and recreational development, and determine site suitabilities for rangeland, forest land, or wildlife habitat. Livestock or wildlife watering facilities are

examples of the potential application of specific guides.

(4) If the present general or specific headings do not meet the desired application in the local area, the user may request a change to the output names. If repackaging of the headings is requested, it is necessary to assure that the proposed application is within the original intent of the interpretation rating guides. In many local areas, implementation of the water management interpretations can make the difference between site enhancement and partial or complete site degradation and failure that impacts the soil resource.

(b) Pond reservoir area.

(1) A pond reservoir area is an area that holds water behind a dam or embankment.

(2) The soils best suited to this use have a low seepage potential, which is determined by permeability and depth to fractured or permeable bedrock, to a cemented pan, or to other permeable material. As shown in Table 620-28, the soil is rated to a depth of 60 inches on its properties and qualities as a natural barrier against seepage into deeper layers, without regard to cutoff trenches or other features that may be installed under the pond embankment. Excessive slope in the direction perpendicular to the axis of the pond embankment seriously reduces the storage capacity of the reservoir area. Suitable sites may be difficult to find on slopes steeper than about 10 percent.

Table 620-28 Pond Reservoir Area.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (ALL DEPTHS)	---	---	MARL, GYP	SEEPAGE
2.	PERMEABILITY (IN/H, 20-60")	<0.6	0.6-2.0	>2.0	SEEPAGE
3.	DEPTH TO BEDROCK HARD (IN)	>60	20-60	<20	DEPTH TO ROCK
3a.	DEPTH TO BEDROCK SOFT (IN)	>60	20-60	<20	DEPTH TO ROCK
4.	DEPTH TO CEMENTED PAN (IN)	>60	20-60	<20	CEMENTED PAN
5.	SLOPE (PCT)	<3	3-8	>8	SLOPE

(c) Embankments, dikes, and levees.

(1) Embankments, dikes, and levees are raised structures of soil material that are constructed to impound water or protect land against overflow. They generally are less than 20 feet high, are constructed of "homogeneous" soil material (without a core zone), and are compacted to medium density. Embankments that have zoned construction (core and shell) are not considered.

(2) As shown in Table 620-29, ratings are made for the soil as a source of material for embankment fills. The rating is given for the whole soil, from the surface to a depth of about 5 feet, based on the assumption that soil horizons will be mixed in loading, dumping, and spreading. The ratings do <u>not</u> indicate the suitability of the undisturbed soil for supporting the embankment. Soil properties to a depth greater than the embankment height have an effect on the performance and safety of the embankment. Generally, deeper onsite geologic investigations must be made to determine these important properties. Low-density silts and clays in the supporting foundation generally have excessive settlement and low strength. Loose soils in arid regions undergo much settlement very rapidly upon becoming saturated as water is impounded. These soils generally do not provide adequate support for embankments.

(3) Embankments, dikes, and levees require soil material that is resistant to seepage, piping, and erosion and that has favorable compaction characteristics. Organic soils are not suitable because of high compression, low strength, and unpredictable permeability. When compacting with tamping rollers (sheepsfoot rollers) or pneumatic rollers, stones over 6 inches in size must be removed; therefore, stony soils are limited for this use. If a water table is present, the depth of usable material and the trafficability are affected.

(4) The content of sodium and salts affects the capability for plant growth on embankment surfaces. These properties may also indicate dispersive soils that are highly erosive and susceptible to piping. Soils that contain gypsum may have piping and uneven settling.

Table 620-29 Embankments, Dikes, and Levees.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
2.	LAYER THICKNESS (IN)	>60	30-60	<30	THIN LAYER
3.	UNIFIED (THICKEST LAYER 10-60")	---	---	GW, GP, SW, SP, GW-GM, GP-GM, SW-SM, SP-SM, SM, GM	SEEPAGE
3a.	UNIFIED (THICKEST LAYER 10-60", >20% PASSING #200 SIEVE)	---	SM, GM	GW, GP, SW, SP, GW-GM, GP-GM, SW-SM, SP-SM	SEEPAGE
3b.	UNIFIED (THICKEST LAYER 10-60", >30% PASSING #200 SIEVE)	SM, GM	---	GW, GP, SW, SP, GW-GM, GP-GM, SW-SM, SP-SM	SEEPAGE
3c.	UNIFIED (THICKEST LAYER 10-60")	---	GM, CL	ML, SM, SP, CL-ML	PIPING
3d.	UNIFIED (THICKEST LAYER 10-60", PI>15)	CL	GM	ML, SM, SP, CL-ML	PIPING
3e.	UNIFIED (THICKEST LAYER 10-60", <35% PASSING #200 & <50% PASSING #40 & <65% PASSING #10 SIEVE)	GM	CL	ML, SM, SP, CL-ML	PIPING
3f.	UNIFIED (THICKEST LAYER 10-60", PI>10)		GM, CL, ML	SM, SP, CL-ML	PIPING
3g.	UNIFIED (THICKEST LAYER 10-60", <70% PASSING #40 & <90% PASSING #10 SIEVE)		GM, CL, SM, SP	ML, CL-ML	PIPING
3h.	UNIFIED (THICKEST LAYER 10-60", <60% PASSING #40 & <75% PASSING #10 SIEVE)	SM, SP	GM, CL	ML, CL-ML	PIPING
3i.	UNIFIED (THICKEST LAYER 10-60")	---	---	OL, OH, PT	EXCESS HUMUS
3j.	UNIFIED (THICKEST LAYER 10-60")	---	---	MH, CH	HARD TO PACK
3k.	UNIFIED (THICKEST LAYER 10-60", PI<40)	---	CH	MH	HARD TO PACK

Table 620-29 Embankments, Dikes, and Levees (continued).

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
4. WEIGHT PERCENT >3" (WEIGHT AVERAGE 0-40")	<15	15-35	>35	LARGE STONES
5. PONDING	---	---	+	PONDING
6. DEPTH TO HIGH WATER TABLE APPARENT (FT)	>4.0	2.0-4.0	<2.0	WETNESS
6a. DEPTH TO HIGH WATER TABLE PERCHED (FT)	>3.0	1.0-3.0	<1.0	WETNESS
7. SODIUM ADSORPTION RATIO (0-40")	---	---	>13	EXCESS SODIUM
8. SALINITY (MMHOS/CM, ANY DEPTH)	<8	8-16	>16	EXCESS SALT

(d) Excavated ponds (aquifer-fed).

(1) An aquifer-fed excavated pond is a body of water created by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface.

(2) As shown in Table 620-30, the soil properties and qualities that affect aquifer-fed excavated ponds are depth to a permanent water table, permeability of the aquifer, and quality of water as determined by inference from the salinity of the soil. Large stones are also considered because of their effect on the ease of excavation.

Table 620-30 Excavated Ponds (Aquifer-Fed).

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE	---	---	ICE	PERMAFROST
1a.	TEXTURE (BELOW 10")	---	COS, G, SG	S, FS, VFS, LCOS, LS, LFS, LVFS	CUTBANKS CAVE
2.	DEPTH TO HIGH WATER TABLE APPARENT (FT)	<2	2-5		DEEP TO WATER
2a.	DEPTH TO HIGH WATER TABLE APPARENT (FT)			>5	NO WATER
2b.	DEPTH TO HIGH WATER TABLE PERCHED (FT)	---	---	+	NO WATER
2c.	DEPTH TO HIGH WATER TABLE (IF NO WATER)				NO WATER
3.	DEPTH TO BEDROCK HARD, (IN)	>60	40-60	<40	DEPTH TO ROCK
4.	PERMEABILITY (BELOW 10", IN/H)	>2.0	0.6-2.0	<0.6	SLOW REFILL
5.	SALINITY (BELOW 10", MMHOS/CM)	<8	8-16	>16	SALTY WATER
6.	WEIGHT PERCENT >3" (WEIGHTED AV. 0-40")	<25	25-50	>50	LARGE STONES

(e) Drainage.

(1) Drainage is the process of removing excess surface and subsurface water from agricultural land. How easily and effectively a soil is drained depends on the depth to the water table, ponding, soil permeability, depth to bedrock or to a cemented pan, flooding, subsidence of organic layers, potential frost action, and slope. The productivity of the soil after drainage depends on the presence of toxic substances in the root zone, such as salts, sodium, sulfur, or on extreme acidity.

(2) The properties and qualities that affect grading, excavation, and stabilization of trench sides or ditchbanks are depth to bedrock or to a cemented pan, large stones, slope (its percentage and complexity), and stability against caving. The soil properties and qualities used in the ratings for drainage are given in Table 620-31.

Table 620-31 Drainage.

PROPERTY		LIMITS	RESTRICTIVE FEATURES
1.	USDA TEXTURE	ICE	PERMAFROST
1a.	TEXTURE (THICKEST LAYER 10-60")	COS, S, FS, VFS, LCOS, LS, LFS, LVFS, SG, G	CUTBANKS CAVE
2.	DEPTH TO HIGH WATER TABLE (FT)	>3	DEEP TO WATER
3.	PONDING	+	PONDING
4.	PERMEABILITY (0-40", IN/H)	<0.2	PERCS SLOWLY
5.	DEPTH TO BEDROCK (IN)	<40	DEPTH TO ROCK
6.	DEPTH TO CEMENTED PAN (IN)	<40	CEMENTED PAN
7.	FLOODING	OCCAS, FREQ	FLOODING
8.	TOTAL SUBSIDENCE	ANY ENTRY	SUBSIDES
9.	WEIGHT PERCENT >3" (THICKEST LAYER 10-60")	>25	LARGE STONES
10.	POTENTIAL FROST ACTION	HIGH	FROST ACTION
11.	SLOPE (PCT)	>3	SLOPE
12.	SALINITY (ANY DEPTH, MMHOS/CM)	>8	EXCESS SALT
13.	SODIUM ADSORPTION RATIO	>13	EXCESS SODIUM
14.	SULFIDIC MATERIALS (GREAT GROUP)	SULFAQUENTS, SULFIHEMISTS	EXCESS SULFUR
15.	SOIL REACTION (ANY DEPTH, pH)	<3.5	TOO ACID
16.		NONE OF THE ABOVE	FAVORABLE

(f) Irrigation.

(1) Irrigation is the controlled application of water to supplement rainfall for the support of plant growth. The soil properties and qualities that affect design, layout, construction, management, or performance of an irrigation system are listed in Table 620-32.

(2) The soil properties and qualities important in the design and management of most irrigation systems are wetness or ponding, a need for drainage, flooding, available water capacity, intake rate, permeability, susceptibility to wind or water erosion, and slope. The soil properties and qualities that influence construction are large stones and depth to bedrock or to a cemented pan. The features that affect performance of the system are the rooting depth, the amount of salts, lime, gypsum, or sodium, and soil acidity.

Table 620-32 Irrigation.

PROPERTY		LIMITS	RESTRICTIVE FEATURES
1.	USDA TEXTURE	ICE	PERMAFROST
1a.	TEXTURE (SURFACE LAYER)	COS, S, FS, VFS, LCOS, LS, LFS, LVFS	FAST INTAKE
1b.	TEXTURE (SURFACE LAYER)	SIC, C, SC	SLOW INTAKE
2.	SLOPE SURFACE (PCT)	>3	SLOPE
3.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 40")	>25	LARGE STONES
4.	PONDING	+	PONDING
5.	DEPTH TO HIGH WATER TABLE (IN FT DURING GROWING SEASON)	<3	SHALLOW TO WATER
6.	AVAILABLE WATER CAPACITY (WEIGHTED AV. TO 40", IN/IN)	<0.10	DROUGHTY
7.	WIND ERODIBILITY GROUP	1, 2, 3	SOIL BLOWING
8.	PERMEABILITY (0-60", IN/H)	<0.2	PERCS SLOWLY
9.	DEPTH TO BEDROCK (IN)	<40	DEPTH TO ROCK
10.	DEPTH TO CEMENTED PAN (IN)	<40	CEMENTED PAN
11.	EROSION FACTOR (K) SURFACE	>.35	ERODES EASILY
12.	FLOODING	OCCAS, FREQ	FLOODING
13.	SALINITY (0-40", MMHOS/CM)	>4	EXCESS SALT
14.	SODIUM ADSORPTION RATIO	>13	EXCESS SODIUM
15.	CALCIUM CARBONATE EQ (PCT, THICKEST LAYER 10-60")	>40	EXCESS LIME
16.	SULFIDIC MATERIALS (GREAT GROUP)	SULFAQUENTS, SULFIHEMISTS	EXCESS SULFUR
17.	SOIL REACTION (pH, ANY DEPTH)	<3.5	TOO ACID
18.		NONE OF THE ABOVE	FAVORABLE

(g) Terraces and diversions.

(1) Terraces and diversions are embankments or a combination of an embankment and a channel constructed across a slope. They control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

(2) The soil properties and qualities that are used in rating soils for terraces and diversions are listed in Table 620-33.

(3) The soil properties and qualities that influence construction are slope, large stones, depth to bedrock or to a cemented pan, and wetness. Other properties and qualities that may cause problems after construction are restricted rooting depth, a high susceptibility to wind or water erosion, and restricted permeability to water and air. A high content of gypsum may cause piping or pitting.

Table 620-33 Terraces and Diversions.

PROPERTY		LIMITS	RESTRICTIVE FEATURES
1.	USDA TEXTURE	ICE	PERMAFROST
1a.	TEXTURE (THICKEST LAYER 10-60")	COS, S, FS, VFS, LCOS, SG	TOO SANDY
2.	SLOPE (PCT)	>8	SLOPE
3.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 40")	>15	LARGE STONES
4.	DEPTH TO BEDROCK HARD (IN)	<40	DEPTH TO ROCK
4a.	DEPTH TO BEDROCK SOFT (IN)	<40	DEPTH TO ROCK
5.	DEPTH TO CEMENTED PAN (IN)	<40	CEMENTED PAN
6.	EROSION FACTOR (K) (0-40")	>.35	ERODES EASILY
7.	PONDING	+	PONDING
8.	DEPTH TO HIGH WATER TABLE (FT)	<3	WETNESS
9.	WIND ERODIBILITY GROUP	1, 2, 3	SOIL BLOWING
10.	PERMEABILITY (10-60", IN/H)	<0.2	PERCS SLOWLY
11.	FRAGIPANS (GREAT GROUPS)	ALL FRAGI	ROOTING DEPTH
12.		NONE OF THE ABOVE	FAVORABLE

(h) Grassed waterways.

(1) Grassed waterways are natural or constructed channels that generally are broad and shallow and are covered with erosion-resistant grasses. They are used to conduct surface water to outlets at a nonerosive velocity.

(2) As shown in Table 620-34, the soil properties and qualities that affect the construction and maintenance of grassed waterways are large stones, wetness, slope, and depth to bedrock or to a cemented pan. The soil properties and qualities that affect the growth of grass after construction are moisture regime, susceptibility to wind or water erosion, available water capacity, rooting depth, presence of toxic substances, such as salts or sodium, and permeability to water and air.

Table 620-34 Grassed Waterways.

PROPERTY		LIMITS	RESTRICTIVE FEATURES
1.	USDA TEXTURE	ICE	PERMAFROST
2.	MOISTURE REGIME OR SUBGROUP	ARIDIC, TORRIC (NOT USTIC SUBGROUP)	TOO ARID
3.	WEIGHT PERCENT >3" (WEIGHTED AV. TO 40")	>15	LARGE STONES
4.	DEPTH TO HIGH WATER TABLE (FT)	<1.5	WETNESS
5.	SLOPE (PCT)	>8	SLOPE
6.	SALINITY (SURFACE LAYER, MMHOS/CM)	>4	EXCESS SALT
7.	SODIUM ADSORPTION RATIO (0-40")	>13	EXCESS SODIUM
8.	EROSION FACTOR (K) (0-40")	>.35	ERODES EASILY
9.	AVAILABLE WATER CAPACITY (IN/IN)	<0.10	DROUGHTY
10.	DEPTH TO BEDROCK HARD (IN)	<40	DEPTH TO ROCK
11.	DEPTH TO CEMENTED PAN (IN)	<40	CEMENTED PAN
11a.	DEPTH TO BEDROCK SOFT (IN)	<40	DEPTH TO ROCK
12.	FRAGIPAN (GREAT GROUP)	ALL FRAGI	ROOTING DEPTH
13.	BULK DENSITY	>1.7	ROOTING DEPTH
14.	PERMEABILITY (0-40", IN/H)	<0.2	PERCS SLOWLY
15.		NONE OF THE ABOVE	FAVORABLE

620.11 Water Quality.

Soil Survey interpretations are developed for use in evaluating and determining the potential of the soil to transmit pesticides through the profile and the likelihood of the contamination of ground-water supplies. Evaluations also consider potential surface runoff and the contamination of surface water.

(a) Pesticide loss potential - leaching.

(1) "Pesticide loss potential - leaching" is the potential for pesticides to be transported by percolating water below the plant root zone. Pesticides in ground-water solution are leached from the soil surface layer and transported vertically or horizontally through the soil and vadose zone by percolating water. Leaching pesticides have the potential to contaminate shallow and deep aquifers, springs, and local water tables.

(2) The pesticides considered available in leaching are those applied to or incorporated into the surface layer of the soil. The Soil Leaching Loss Rating (SLLR) is a value derived from the soil algorithm which was developed by using the GLEAMS model to rank various soil and pesticide properties (Goss et al., 1988). The SLLR algorithm is defined as:

SLLR = (Surface Layer Depth)*(Organic Matter Content).

(3) Precipitation, either as rain, sleet, or snow, and irrigation are considered the major sources of soil moisture available for leaching pesticides through the soil and vadose zone. The Aridic and Ustic moisture regimes are given one lower Surface Leaching Loss Rating because the drier climate conditions are associated with these regimes if they are not irrigated.

(4) The soil properties and qualities considered are those that affect soil attenuation capacity, water infiltration, and soil permeability. As shown in Table 620-35, these soil properties are soil texture, surface layer thickness, organic matter content, structure, bulk density, permeability of soil or bedrock, shrink-swell potential, depth to rock, depth to water table, and slope.

(5) Soil attenuation capacity is represented by the SLLR (Soil Leaching Loss Rating). Infiltration rate is interpreted from slope and the soil hydrologic group which considers soil texture, permeability, restrictive layers, depth, and shrink-swell potential. Soil permeability is a function of soil structure, particle-size distribution, and bulk density; presence of a restricting layer; and depth to that restricting layer. Bedrock permeability is related to the type, size, extent, and interconnection of fractures and bedding planes. Bedrock permeability should be evaluated on a State or regional level for those soils that have bedrock at a depth of less than 60 inches.

(6) The soil rating guide is based on the potential for soils to retain pesticides within the boundaries of the root zone and is not directed toward any particular pesticide or family of pesticides. For the purpose of this guide, pesticides are considered to be applied to bare soil by either surface or aerial methods.

Table 620-35 Pesticide Loss Potential - Leaching.

		LIMITS			
	PROPERTY	SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	SOIL LEACHING LOSS RATING 1/ FOR HYDROLOGIC GROUP A 2/				
1a.	SLOPE 0-15%	>65	30-65	<30	LOW ADSORPTION
1b.	SLOPE 15+%	>30	<30	---	LOW ADSORPTION
2.	SOIL LEACHING LOSS RATING 1/ FOR HYDROLOGIC GROUP B 2/				
2a.	SLOPE 0-15%	>45	5-45	<5	LOW ADSORPTION
2b.	SLOPE 15+%	>5	<5	---	LOW ADSORPTION
3.	SOIL LEACHING LOSS RATING 1/ FOR HYDROLOGIC GROUPS C & D	ALL	---	---	
4.	DEPTH TO HIGH WATER TABLE (FT)	>4	2-4	<2	WETNESS
5.	DEPTH TO LAYER WITH PERMEABILITY (>6.0 IN/HR) (IN)	>60	24-60	<24	SEEPAGE
6.	DEPTH TO BEDROCK WITH PERMEABILITY (> 2.0 IN/HR 3/)				
6a.	HYDROLOGIC GROUPS A & B	>60	---	<60	POOR FILTER
6b.	HYDROLOGIC GROUP C	>40	20-40		POOR FILTER
6c.	HYDROLOGIC GROUP D PERMEABILITY (< 2.0 IN/HR) 3/	>40	20-40	<20	POOR FILTER
6d.	HYDROLOGIC GROUP (ALL)	>20	<20	---	POOR FILTER

1/ Soil Leaching Loss Rating (SLLR) = (Surface Layer Depth)*(Organic Matter Content).

2/ Reduce rating limitations one class for Aridic moisture regime unless irrigated.

3/ Bedrock permeability is related to the type of bedrock and the size, extent, and interconnection of fractures and bedding planes.

(b) Pesticide loss potential - soil surface runoff.

(1) "Pesticide loss potential - soil surface runoff" is the potential for pesticides to be transported by surface runoff beyond the field boundary where the pesticide was applied. Pesticides are transported by surface runoff as either pesticides in solution or pesticides adsorbed to sediments suspended in runoff. Pesticides that are surface transported have a potential to contaminate surface waters, such as lakes, ponds, streams, and rivers.

(2) The pesticides considered available to surface loss are those applied to the surface of the soil. Loss occurs from either pesticides moving in runoff solutions or pesticides attached to sediments moving with surface runoff. The Surface Loss Rating (SLR) is a value derived from the soil algorithm which was developed by applying the GLEAMS model to rank various soil and pesticide properties (Goss et al., 1988). The SLR is a function of hydrologic groups and K values and is determined using the following criteria:

- -- For all soils in Hydrologic Group A, the SLR is < 0.
- -- For soils in Hydrologic Group B with a K factor ≤.17, the SLR is 0 to < 1.0.
- -- For soils in Hydrologic Group B with a K factor >.17, for all soils in Hydrologic Group C, and for soils in Hydrologic Group D with a K factor ≤.20, the SLR is 1.0 to 2.8. and
- -- For soils in Hydrologic Group D with a K factor >.20, the SLR is >2.8.

(3) The soil properties and qualities considered in the pesticide surface loss guide, as given in Table 620-36, are those that affect rates of runoff and erosion. These soil properties and qualities are soil texture, organic matter content, structure, particle-size distribution, permeability, restricting layers, depth, drainage, depth to a water table, slope, and shrink-swell potential. Runoff is represented by slope and the soil hydrologic group, which considers soil texture, permeability, restrictive layers, depth, drainage, and shrink-swell potential. Soil erodibility is represented by the K factor, which is estimated from soil particle-size distribution, organic matter content, structure, and permeability. Flooding has the potential of catastrophic surface pesticide loss. It may remove large quantities of pesticides, either those in solution or those adsorbed to sediments, in a single event. Ponding can concentrate pesticides that are surface transported, and draining ponded areas adversely affects the receiving surface waters.

(4) The soil rating guideline is based on the potential for soils to retain pesticides within the boundaries of the field where they are applied and is not directed toward any particular pesticide or family of pesticides. For the purpose of this guide, pesticides are considered to be applied to bare soil by either surface or aerial methods.

Table 620-36 Pesticide Loss Potential - Soil Surface Runoff.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	SOIL LOSS RATING 1/				
1a.	SLOPE 0-2% 2/	ALL	---	---	
1b.	SLOPE 2-6%	<1.0	1.0-2.8	>2.8	EXCESS RUNOFF
1c.	SLOPE 6-15%	---	<2.8	>2.8	EXCESS RUNOFF
1d.	SLOPE 15%+	---	<0	>0	EXCESS RUNOFF
2.	FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
3.	PONDING 3/	UNDRAINED	---	DRAINED	DRAINED ARTIFICIAL
4.	USDA TEXTURE			ICE	PERMAFROST

< 0.0:	(All soil in Hydrologic Group A)
0 to < 1.0:	(Soil in Hydrologic Group B with a K factor ≤.17)
1.0 to 2.8:	(Soil in Hydrologic Group B with a K factor >.17; all soil in Hydrologic group C; and soil in Hydrologic Group D with a K factor ≤.20)
>2.8:	(Soil in Hydrologic Group D with a K factor >.20)

620.12 Forest Land Suitability.

(a) General.

(1) Soil interpretations for forest land suitability are made for all areas in which forest is the present or potential land use. These interpretations are a tool for evaluating existing conditions in planning and predicting the soil response to various systems of forest land management. The probability of seedling survival; competition between desirable species and other plants, especially if the site is disturbed; the relative danger of erosion if cover is removed; the resistance of trees to windthrow; and problems for equipment use are some of the management considerations addressed by the soil interpretation

1/ Soil Loss Rating = (SLR).

2/ Irrigation induced erosion must be considered.

3/ Drainage is considered if it is artificial and if the discharges are into surface water bodies or regional drainage systems.

guides. The ratings are for soils in their natural condition and do not consider present land use, accessibility, or other factors related to forest land use. The limitation ratings for each interpretation are based on the influence of existing soil properties and qualities on that use. When rating a soil, the degree of limitation and the most restrictive soil features are identified. Soils with MODERATE or SEVERE limitations may require extreme measures or conservation practices designed to overcome the limitations. Soils with SLIGHT limitations require no measures in addition to the normal local procedures used in forest land management.

(2) Native vegetation is common to forest land. It is usually dominated by an understory of woody shrubs, forbs, grasses, mosses, and lichens. Forest land management in many areas includes improved tree species. Many areas managed as forest land periodically produce understory vegetation suitable for forage, which may be managed for grazing by wildlife and livestock. Management of these areas begins with an understanding of the soil. The information provided in soil surveys can be used effectively in planning and assisting the management of forest land. The soil interpretation rating guides are designed to meet these needs but are also useful in the management or rehabilitation of grazed forest land, recreational uses, and wildlife habitat needs.

(b) Haul roads and major skid trails.

(1) Haul roads and major skid trails are local roads within or adjacent to a forest land area. They are used to haul wood products from an area being harvested. Timber haul roads ends where it runs into a collector road or directly onto an arterial road. These roads are used to provide a fixed route of travel for moving wood products, equipment, and supplies and to provide access for the proper operation, maintenance, protection, and management of conservation enterprises while controlling runoff to prevent erosion and maintain the water quality within a forest land harvest area.

(2) The properties and qualities used in rating soils for timber haul roads and major skid trails are listed in Table 620-37. Soil wetness is a critical property in evaluating soils for low standard roads. If the water table is at a depth of 12 inches or less, roads should not be used and silvicultural practices temporarily halted or other methods of ingress and egress should be utilized.

(3) Soil slope influences the design and construction of roads. The road prism has different effects on mass stability and hydrologic functioning of the watershed according to changes in slope gradient.

Table 620-37 Haul Roads and Major Skid Trails.

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. DURATION OF WATER TABLE ABOVE 12 IN. (MONTH)	<1	1-3	>3	WETNESS
2. SOIL DRAINAGE 1/	EXCESSIVE, SOMEWHAT EXCESSIVE, & WELL	MOD. WELL	SOMEWHAT POORLY, POORLY, & VERY POORLY	WETNESS
3. USDA TEXTURE 2/ (SURFACE, 10")	---	COS, S, FS, VFS, SCL, SIL, L, CL	SC, SICL, SIC, C, PEAT, MUCK	EXCESS FINES
4. FAMILY PARTICLE-SIZE CLASS	SANDY-SKL LOAMY-SKL SANDY CO-LOAMY	CLAYEY-SKL FINE-LOAMY CO-SILTY FINE-SILTY MEDIAL	CLAYEY HYDROUS	EXCESS FINES
5. UNIFIED 3/	GM, SM, GW, SW	SP, SC, GP		LOOSE MATERIAL
		ML, CL, GC	CH, MH	EXCESS FINES
6. AASHTO 3/	A-1, A-2	A-3		LOOSE MATERIAL
		A-4, A-5, A-6	A-7 A-8	EXCESS FINES ORGANIC
7. FLOODING HAZARD	NONE, RARE	OCCAS	FREQ	FLOODING
8. SLOPE PERCENT 4/	<15	15 TO 30	>30	SLOPE
9. COBBLES PERCENT SURFACE COVERED	<15	15 TO 30	>30	TOO COBBLY
10. STONES PERCENT SURFACE COVERED	<3	3 TO 15	>15	TOO STONY
11. BOULDERS PERCENT SURFACE COVERED	<0.1	0.1 TO 3	>3	TOO BOULDERY
12. STABILITY 5/	STABLE	MODERATELY STABLE	UNSTABLE	STABILITY

1/ Referenced in the *Soil Survey Manual*, Chapter 4, 1993, USDA-SCS.

2/ If sands are well graded, rate SLIGHT. (Use graduation Index.)

3/ Unified soil group and AASHTO soil group apply to the average of the surface to a depth of 2 feet where slopes are less than or equal to 5 percent. An additional foot of thickness is considered for each additional 5 percent of slope in order to account for cutting that may be needed.

4/ Slope refers to the slope of the land and not to the grade of the road.

5/ Stable soils are generally not subject to mass movement. In moderately stable soils, moderate disturbances may result in mass movement when soil is wet or loaded, or both. In unstable soils, slight disturbances are likely to result in mass movement when soil is wet or loaded, or both.

(c) Log landings.

(1) A log landing is an area within or adjacent to the tree harvesting area where logs are yarded after being felled. Several attributes are considered when locating a landing. Location within the logging area, in order to keep yarding distances to a minimum, and location in relation to the local haul road are prime considerations. The soil needs to be considered as it affects equipment operability and the conservation needs of the forest land. Soil wetness, strength, slope, and the amounts of cobbles, stones, and boulders in and on the soil affect the suitability of a site for landings.

(2) The soil properties and qualities used in rating soils for log landings are listed in Table 620-38. Soil wetness is a critical factor in evaluating soils for landings. When the water table is at or above a depth of 15 inches, logging operations should be halted.

(3) Soil slope gradient is also an important property. Many activities by personnel and using equipment take place in the landing area. Gentle slopes help to minimize the cost of logging operations and reduce impacts on the site.

Table 620-38 Log Landings.

PROPERTY	LIMITS: SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. DURATION OF WATER (ABOVE 15", MONTHS)	<1	1 TO 3	>3	WETNESS
2. SOIL DRAINAGE CLASS 1/	E, W	MW	SP, P, VP	WETNESS
3. FLOODING 2/	NONE, RARE	OCCAS	FREQ	FLOODING
4. USDA TEXTURE 3/ (SURFACE 10")	LS, SL, L	SIL, CL, SCL	C, SIC, SC SICL	EXCESS FINES
			PEAT, MUCK	EXCESS HUMUS
		COS, S, FS, VFS		LOOSE MATERIAL
6. FAMILY PARTICLE-SIZE CLASS	SANDY-SKEL LOAMY-SKEL SANDY COARSE-LOAMY	CLAYEY-SKEL. FINE-LOAMY COARSE-SILTY FINE-SILTY	CLAYEY	EXCESS FINES
		FRAGMENTAL		FRAGMENTAL
7. SOIL ORDER			HISTOSOLS	EXCESS HUMUS
8. UNIFIED 4/	GM, GW, SM SW	GP, SP, SC		LOOSE MATERIAL
		GC, ML, CL	CH, MH	EXCESS FINES
			OL, OH	LOW STRENGTH
9. AASHTO 4/	A-1, A-2	A-4, A-5, A-6	A-7	LOW STRENGTH
			A-8	EXCESS HUMUS
		A-3		LOOSE MATERIAL
10. SLOPE (PERCENT)	0 TO 6	6 TO 12	>12	SLOPE

Table 620-38 Log Landings (continued).

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
11.	COBBLES (3 TO 10" DIAMETER) PERCENT SURFACE COVERED	0 TO 15	15 TO 50	>50	TOO COBBLY
12.	STONES (10 TO 24" DIAMETER) PERCENT SURFACE COVERED	0 TO 3	3 TO 15	>15	TOO STONY
	CLASS	1, 2	3	4, 5, 6	
13.	BOULDERS (>24" DIAMETER) PERCENT SURFACE COVERED	0 TO 0.1	0.1 TO 3	>3	TOO BOULDERY
	CLASS	1	2	3, 4, 5, 6	
14.	LANDSCAPE STABILITY HAZARD	LOW		HIGH	SLIPPAGE

1/ Reference in the *Soil Survey Manual*, Chapter 4, 1993, USDA-SCS.

2/ Soils that are frequently flooded may be rated MODERATE if the time and duration of flooding is normally limited to one season of the year. (If duration is brief, rate down to MODERATE.)

3/ If sands are well graded, rate SLIGHT.

4/ Unified soil group and AASHTO soil group apply generally to the average of the material to a depth of 2 feet where slopes are 5 percent or less. An additional foot of depth is considered for each additional 5 percent of slope in order to account for any cutting which may be needed.

(d) Equipment operability for logging areas.

(1) This rating applies to the use of rubber-tired skidders in the general logging area, including the yarding area for felled or bunched trees or logs and that extends to a designated skid trail.

(2) The soil properties and qualities used in rating soils for equipment operability in logging and their limitations are listed in Table 620-39. Slope, slope stability, and soil wetness are major considerations in rating soils for equipment operability.

Table 620-39 Equipment Operability for Logging Areas.

PROPERTY	LIMITS: SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. SLOPE (PERCENT)	<20	20 TO 35	>35	SLOPE
2. LANDSCAPE STABILITY HAZARD	LOW		HIGH	SLIPPAGE
3. DURATION OF WATER TABLE ABOVE 12" (MONTHS)	<3	3 TO 6	>6	WETNESS
4. STONES (10 TO 24" DIAMETER, PERCENT OF SURFACE COVERED)	<15	15 TO 50	>50	TOO STONY
CLASS	1, 2, 3	4	5, 6	
5. BOULDERS (>24" DIAMETER, PERCENT OF SURFACE COVERED)	<3	3 TO 15	>15	TOO BOULDERY
CLASS	1, 2	3	4, 5, 6	
6. USDA TEXTURE (AVERAGE OF SURFACE 10 IN) 1/	LS, SL, L, SIL, CL, SCL	S		LOOSE MATERIAL
		C, SIC, SC, SI, SICL		EXCESS FINES
			PEAT, MUCK	EXCESS HUMUS
7. FLOODING FREQUENCY	NONE, RARE, OCCAS	FREQUENT, VERY BRIEF, BRIEF	OTHER	FLOODING

(e) Total tree harvesting.

(1) Total tree harvesting consists of yarding the entire tree to the landing area. Factors considered in rating soils for this practice are the nutrient status of the soil and the effects of removing the tops of trees, which would otherwise be incorporated back into the soil. Also considered is the erosion potential of the soil and the effects of removing slash, which would be a protective factor for the soil.

(2) The soil properties and qualities used to rate soils for total tree harvesting and their limitations are listed in Table 620-40.

1/ Well graded sands should be rated SLIGHT.

Table 620-40 Total Tree Harvesting.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	"A" HORIZON: THICKNESS (IN)[1/]	>3	1 TO 3	<1	THIN SURFACE
1a.	ORGANIC MATTER (PERCENT)	>4	2 TO 4	<2	LOW ORGANIC MATTER
1b.	CATION EXCHANGE CAPACITY (meq. 100g-1)	>15	10 TO 15	<10	LOW CEC
2.	SUBSOIL: CATION EXCHANGE CAPACITY (meq. 100g-1)	>10	3 TO 10	<3	LOW CEC
3.	EFFECTIVE ROOTING DEPTH (INCHES) [2/]	>30	15 TO 30	<15	RESTRICTIVE LAYER
4.	SOIL ERODIBILITY FACTOR T/(RKLS)	>0.10	0.04 TO 0.10	<0.04	ERODES EASILY

(f) Mechanized site preparation and planting equipment.

(1) Certain activities are necessary after timber harvest to regenerate the trees in the area. The guides consider the soil properties and qualities that affect the use of equipment for site preparation and for planting. The guides also consider site quality.

(2) Table 620-41 lists the soil properties and qualities, limits, and restrictive features used in rating soils for mechanized site preparation and planting equipment. Erosion control is very important to maintaining site quality. The guides consider those soil properties that affect soil erodibility.

(3) Other factors that affect site preparation and planting are soil wetness, soil depth, and the amount of cobbles, stones, or boulders on the surface.

1/ If a spodic horizon exists in sandy soils, rate one class higher (i.e. LESS SEVERE.)

2/ The depth is considered to a restrictive layer.

Table 620-41 Mechanized Site Preparation and Planting Equipment.

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. SOIL ERODIBILITY INDICATOR [T/(RKLS)]	>0.10	0.03 TO 0.10	<0.03	ERODES EASILY
2. USDA SURFACE TEXTURE	LS, SL, L, SIL, SCL	C, SIC, SC		EXCESS FINES
		ALL SANDS	GRAVEL	LOOSE MATERIAL
			PEAT, MUCK	EXCESS HUMUS
3. SOIL DEPTH (INCHES TO ROOT RESTRICTIVE LAYER)	>40	20 TO 40	<20	RESTRICTIVE LAYER
4. SOIL DRAINAGE CLASS	MW, W	E, SE, SP	P, VP	WETNESS
5. WATER TABLE, DURATION OF SATURATED ZONE ABOVE 15 INCHES (MONTHS)	<3	3 TO 6	>6	WETNESS
6. FLOODING --FREQUENCY --DURATION --MONTHS	NONE, RARE, OCCAS	FREQ, V BRIEF, BRIEF	FREQ, LONG, V LONG	FLOODING
7. COBBLES (3-10 INCHES, PERCENT SURFACE COVERED)	<15	15 TO 25	>25	TOO COBBLY
8. STONES (10-24 INCH DIAMETER, PERCENT SURFACE COVERED)	<3	3 TO 15	>15	TOO STONY
STONINESS CLASS	1, 2	3	4, 5, 6	
9. BOULDERS (>24 INCH DIAMETER, PERCENT SURFACE COVERED)	<1	1 TO 3	>3	TOO BOULDERY
STONINESS CLASS	1, 2	2	3, 4, 5, 6	

(g) Chemical site preparation.

(1) This rating guide considers the soil and site properties and qualities that allow chemicals to either runoff a site or to percolate through the soil to an aquifer or other ground water.

(2) Table 620-42 lists the properties and qualities of soils, their limits, and their restrictive features.

Table 620-42 Chemical Site Preparation.

	PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE 10")	C, CL, SICL, SIL, L, SL	LS, S	COS	EXCESS PERMEABILITY
2.	FAMILY PARTICLE-SIZE CLASS	LOAMY, CLAYEY, CLAYEY/SKEL	SANDY, LOAMY-SKELETAL	FRAGMENTAL, SANDY-SKEL.	EXCESS PERMEABILITY
3.	SOIL DRAINAGE CLASS	W, MW		E, SE	RAPID DRAINAGE
			SP	VP	WETNESS
4.	WATER TABLE				
	--DEPTH (FEET)	---	---	<1.5	WETNESS
	--DURATION	V BRIEF	BRIEF	LONG, V LONG	
5.	SURFACE RUNOFF CLASSES 1/	N, VL, L	M	H, VH	RUNOFF
6.	FLOODING				
	--FREQUENCY	NONE, RARE, OCCAS	FREQ	FREQ, LONG, V LONG	FLOODING
	--DURATION		V. BRIEF, BRIEF		

(h) Prescribed burning.

(1) Prescribed burning is the deliberate ignition of a combustible material. Foresters use fire to perform three basic functions: consume dead organic material, alter living vegetation, and produce a desired ecological effect. The three functions are not mutually exclusive. Burning dead material inevitably affects the vegetation. The ecological function is, to some extent, a synthesis of other functions. Soil properties are considered in prescriptions for burning not from the standpoint of the actual ignition but from the standpoint of the management objectives of the desired ecological effect.

(2) The affects of prescribed burning on the vegetation are influenced by the soil. Therefore, the soil should be considered when preparing a burning plan. The soil properties and qualities considered are slope, soil texture, drainage class, depth to a restrictive layer, and the presence and thickness of an O horizon.

(3) Table 620-43 lists the properties and qualities of soils, their limits, and their restrictive features. Soils rated SLIGHT have few limitations that affect the reestablishment of vegetation. Soils that have MODERATE limitations require post-burning practices to achieve the desired results. Soils that have SEVERE limitations require post-burning practices to achieve the desired erosion control.

1/ The soil surface runoff classes are defined as follows: Negligible - N; Very Low - VL; Low - L; Medium - M; High - H; and Very High - VH. (*Soil Survey Manual*, Table 3-10.)

Table 620-43 Prescribed Burning.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	SLOPE (PERCENT)	<35	35 TO 55	>55	SLOPE
2.	SOIL TEXTURE (SURFACE 10 INCHES) 1/	CL, SICL, LVFS, SI, SIL, L, FSL, SL, VFSL	SC, SIC, C, LS, LFS, LCOS	S, FS, COS PEAT, MUCK	TOO CLAYEY TOO SANDY ORGANIC
3.	FINEST TEXTURE LAYER WITHIN 60 INCHES	---	---	SAND (UNLESS SPODIC)	TOO SANDY
4.	DRAINAGE CLASS	---	SE	E	DROUGHTY
5.	EFFECTIVE ROOTING DEPTH	>36	12 TO 36	<12	RESTRICTIVE LAYER
6.	THICKNESS OF "O" HORIZON (INCHES)	>1	1	<1	THIN LAYER

(i) Seedling mortality.

(1) Seedling mortality refers to the probability of the death of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions.

(2) It is important for forest managers to be aware of the seedling mortality hazard and of the soil properties or qualities that contribute to seedling mortality. To offset this hazard, it may be necessary to use special planting stock that is larger than usual or containerized or to do special site preparation, such as bedding, furrowing, or surface drainage. Reinforcement planting may also be needed.

(3) Table 620-44 lists the properties and qualities, limits, and restrictive features used in rating soils for seedling mortality. Seedling mortality is caused mainly by too much water (soil wetness) or too little water (soil droughtiness). Too much water is caused by a seasonal high water table or flooding during a significant part of the growing season. Soils that are poorly drained, very poorly drained, or frequently flooded have severe seedling mortality. Poorly drained soils have a severe hazard.

(4) Soil droughtiness is caused by several factors, including lack of rainfall at the right time, low available water capacity, shallow rooting depth, high evaporation, or a combination of these factors. Seedlings can survive on soils that have a low available water capacity if rainfalls come at the right time, at the right frequency, and for the right duration. If the frequency and duration of rainfall are less than optimum, the amount of water that enters the soil and is held within the root zone becomes the critical factor in determining seedling mortality.

(5) The surface layer must be coarse enough to allow water to enter readily but not so coarse that it has a low available water capacity. Seedling mortality is greatest on soils that have a clayey surface layer.

(6) The amount of water held in the soil for plant use is determined by the available water capacity of the soil and the effective rooting

1/ If a spodic horizon exists in sandy soils, rate one class higher (i.e. LESS RESTRICTIVE).

depth. The amount of water held within a 20-inch effective rooting depth is used as an indicator of droughtiness.

(7) Seedling mortality may be affected by high temperatures and evaporation, such as those associated with steep, south-facing slopes.

(8) For soils rated SLIGHT, few or no problems are expected from mortality under usual conditions; mortality is less than 25 percent. For soils rated MODERATE some problems of mortality may be expected and extra precautions are advisable; expected mortality without extra precautions is 25 to 50 percent. For soils rated SEVERE extra precautions are important and replanting may be necessary and should be factored into planning; expected mortality with extra precautions is more than 50 percent.

Table 620-44 Seedling Mortality.

	PROPERTY	LIMITS			RESTRICTIVE FEATURE
		SLIGHT	MODERATE	SEVERE	
1.	USDA TEXTURE 1/ 2/ (SURFACE 10 IN)	SL, FSL, SIL	LS, LFS, S	C, SIC, SC	DROUGHTY
1a.		VFSL, L, LVFS	CL, SCL, SICL	C, SIC, SC	TOO CLAYEY
1b.				PEAT, MUCK	ORGANIC
2.	DRAINAGE CLASS	W, MW	SP	VP, P E, SE	WETNESS DROUGHTY
3.	ROCK FRAGMENTS PERCENT BY WEIGHT >2MM 3/ (SURFACE 10" IN)	<50	50 TO 75	>75	ROCK FRAGMENTS
4.	EFFECTIVE ROOTING DEPTH (INCHES) 4/	>20	10 TO 20	<10	RESTRICTIVE LAYER
5.	SLOPE (PERCENT)				
	N & E ASPECTS	ALL	---	---	
	S & W ASPECTS	<15	15 TO 35	>35	DROUGHTY

(j) Plant competition.

(1) Plant competition is the likelihood that plants other than the desired species will become established during revegetation efforts and that their presence will affect seedling establishment and the growth of desired species.

(2) Table 620-45 lists the properties and qualities, limits, and restrictive features used in rating soils for plant competition. A MODERATE or SEVERE rating indicates the need for increased or more intensive site preparation. High natural productivity is a factor that affects plant competition. It is good for the desired species but also gives competing vegetation the advantage. Separate ratings should not be made for deciduous or coniferous species.

(3) For soil rated SLIGHT, the competition of unwanted plants is not likely to prevent the development of natural regeneration or suppress the more desirable species. Planted species have good prospects for development without undue competition from other species of vegetation. For soils rated MODERATE, competition may delay the establishment of the natural desired species or planted species and may hamper the vegetative community development. In the case of reforestation, it will not prevent the eventual development of fully stocked stands. For soils rated SEVERE, competition can be expected to prevent the regeneration of natural or planted

1/ If a spodic horizon exists in sandy soils, rate one class higher (i.e. LESS RESTRICTIVE).

2/ If precipitation during the frost free period is less than 25 inches, rate loamy sands as SEVERE.

3/ This figure is the sum of the fract. >10 in. plus the fract. 3-10 in. plus (100 minus the percent passing the No. 10 sieve). It is approximated to the 35 percent and 50 percent, by volume, rock fragments and rounded to the nearest 5 percent.

4/ The depth is considered to a restrictive layer.

species unless precautionary measures are taken.

Table 620-45 Plant Competition.

PROPERTY	LIMITS: SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. SOIL DRAINAGE CLASS	E, SE, W	MW, P, VP	SP	HIGH AVAILABLE WATER CAPACITY
2. AVAILABLE WATER CAPACITY (AV. 40 INCHES OR RESTRICTIVE LAYER) (IN)	<2	2 TO 5	>5	HIGH AVAILABLE WATER CAPACITY
3. pH			≤5.0 ≥7.9	TOO ACID TOO ALKALINE

620.13 Wildlife Habitat Suitability.

(a) General.

(1) Wildlife habitat suitability interpretations provide a tool for habitat management. Soils vary in their capacity to produce various plants for use as wildlife habitat and are used as habitat by specific animal species. The rating are for the soils in their natural condition and do not consider present land use, existing vegetation, water sources, and the presence or absence of wildlife in the area. Site evaluation and planning, however, should consider these items.

(2) It is recommended that the habitat be identified and a list be made of the local, native, or introduced plant or animal species that are adapted to each of the broader habitat elements. The list may be subdivided according to species adaptation to soil features.

(3) Management for wildlife habitat may involve part or all of one or more soil components. Habitat areas may need to be long narrow strips, patches, large blocks, or other variations depending upon the targeted species.

(4) Groups of soil components or map units can be made for each wildlife habitat element. Similar suitability ratings or soil features can be grouped for common habitat elements. Ratings and restrictive features aid in the selection of sites for habitat management.

(5) Soils may be rated for two or more habitat elements when they are used in developing transitional habitat.

(6) Ratings reflect the suitability of the soil for specific wildlife habitat elements. Restricting soil features guide the user in predicting how the soil will respond to management.

(7) The steps to successful planning are as follows:

- -- Identify important habitat elements adapted to the local area.
- -- Identify the map units and soils for the area under consideration.
- -- Obtain the soil ratings and restrictive soil features for each habitat element.
- -- Compare the soil ratings and restrictive features with the list of locally or regionally adapted subgroup plant or animal species. The lists are developed and maintained in the field office technical guide.
- -- Depending upon the habitat element desired, the species adapted to each soil interpretation can be identified and selected. Decisions can be made to implement management based on the possibility for success of each specific habitat rating.

(8) For example, the locally or regionally adapted species, referred to above, may be one for which the broad category rating for riparian shrubs, vines, and tree habitat element is POORLY SUITED. The restrictive feature is a water table that is at a depth of more than 5 feet during the growing season. The desired habitat species is cottonwood trees. A review of the list of subgroup species for this broad category noted the following:

(i) If the soil is rated WELL SUITED, the water table is close enough to the soil surface and flooding is sufficient to promote natural regeneration of cottonwood where seed sources are available and grazing management is implemented. Planted root stock and poles can also be used to establish a stand. The stand will be maintained by the water table.

(ii) If the soil is rated SUITED, the water table is at a depth that limits soil moisture and thus natural regeneration of cottonwood will not occur. However, if root stock or poles are planted at or near the water table, the moisture supply is sufficient to maintain the stand.

(iii) If the soil is rated POORLY SUITED, cottonwood is not capable of regeneration and planted root stock or poles will require irrigation at least until the roots reach the water table, if it is within a depth of about 8 to 10 feet, and may require irrigation for the life of the stand.

The above procedure give the user the necessary tools for identifying alternatives and making management decisions.

(b) Grain and seed crops for use as food and cover for wildlife habitat.

(1) The soil is interpreted as a medium for growing grain and seed crops, which are a component of specific local habitat requirements for targeted and nontargeted species of wildlife. The purpose of the ratings is to provide guidelines in the selection of soils, sites, and plant species for wildlife habitat and not to reflect commercial agronomic production.

(2) The guide, as shown in Table 620-46, is to be used in planning the production of nonirrigated commercial grain and other seed or vegetative producing annuals for wildlife food and cover. The annual vegetation species that are selected are usually planted at least once each year. The use of annual tillage may increase the potential for soil erosion and, therefore, the use of conservation practices is required to minimize the hazard. If appropriate, the soils may receive supplemental fertilization and liming to increase vegetation growth rates and seed production. Depending upon the objectives of the user, the plant species selection and management techniques will dictate whether the habitat will be dominantly used for food, cover, or both. The height and structure of the vegetation species are important considerations in addressing wildlife cover relationships.

(3) The interpretations provide suitability ratings and identify the dominate soil characteristics that influence the suitability of the site for growing grain and seed corps. They allow the user to plan and develop alternatives in site selection and to select the grain and seed species that best meet the wildlife habitat requirements. The user is required to develop a list of locally adapted annual cover, grain, and seed species.

(4) Soils that are WELL SUITED have no restrictions to use and are favorable for locally adapted annual vegetation species that are used for wildlife habitat. Adapted species may be grown individually or in combination with other adapted species. A SUITED rating implies that the site is suitable for the growth of climatically adapted vegetation species for habitat and that some restrictive features may limit the full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and, thus, affect the value of the grain and seed crop as food or cover for wildlife habitat.

(5) The frost-free season is not considered as a rating criterion but is important in making the final selection of local climatically adapted cover, grain, and other annual seed-producing species for wildlife habitat. Aspect, carbonates, cation exchange capacity, and reaction (pH) were also not addressed. These properties are found to be too variable between vegetation species. These criteria are better applied at the local level in the final selection of species.

(6) The final selection of a site and suitable annual vegetation species for use in providing food and cover for wildlife is determined by the limitation of the soil such as how it influences plant establishment, survival, growth, and vigor. The guide identifies the soil restricting features that will have the most affect on annual vegetation species as habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Planting techniques, seedling emergence, and survival are adversely affected.

1a &1b--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds are affected. Seedling emergence and survival are also affected by drying of the surface layer and the formation of surface crusts.

1c--A high content of organic matter, especially the more fiberous materials, affects seedbed preparation and planting and may indirectly affect soil moisture relationships, fertility, subsidence, and the degree of wind erosion.

2--High concentrations of rock fragments adversely affect the use of mechanical equipment in preparing the soil as a seedbed to be planted with grain or other seed-bearing species for food or cover.

3--A low available water capacity (AWC) means that the ability of the soil to provide moisture to the plants is lower than is desirable for grain and other annual seed crops. Planting drought resistant species minimizes the impact of low available soil moisture.

4 & 5--Bedrock or a cemented pan can restrict root penetration. Species that have shallow rooting systems adapt better to the site.

6--Soils that are dry most of the time may not recharge soil moisture and sustain grain and other annual seed species. The use of a fallow cropping system and the selection of drought resistant species may help to overcome this limitation.

7--A seasonal high water table can affect plant growth and survival. It results in poorly aerated soils which restrict root respiration and total plant growth. Species that are tolerant to wetness are more desirable for establishing wildlife habitat.

8--Ponding can influence seedbed preparation, seedling emergence, and stand survival during the growing season. Planting species tolerant to wet soil conditions minimizes the impact of this limitation.

9--The frequency, timing, and duration of flooding can influence seedbed preparation, seedling emergence, and stand survival. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation.

10 & 10a--The slow movement of water through the soil can cause wet soil conditions for extended periods which affect seedbed preparation, planting dates, and subsequent plant growth. Planting species that are tolerant to moderately wet soil conditions minimizes the impact of this limitation.

11--A steep slope affects soil erosion and the use of mechanical equipment. If the slope is extreme, it may be better to select an alternative site.

12--Excess water-soluble salts restrict the growth of most plants. They also reduce viable seed germination and seedling survival. The selection and management of plant species that are tolerant of saline conditions can minimize the effect of the salts.

13--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict the growth of plants. Crusting and blocked pores reduce air movement and soil permeability. Soil amendments can sometimes alleviate the problem, but it is often better to select a new site.

14 & 15--A susceptibility to soil erosion requires the implementation of conservation practices and limits the selection of species to those that will protect the soil from erosive forces.

Table 620-46 Grain and Seed Crops for Use as Food and Cover for Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	SL, FSL, VFSL, SIL, SI	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER, OXIDIC, KAOLONITIC, MINERALOGY)	----	C, SIC, SC	----	TOO CLAYEY
1b.	USDA TEXTURE (SURFACE LAYER, MIXED, MONTMORILLONITIC MINERALOGY)	----	CL, SICL, SCL	C, SIC, SC	TOO CLAYEY
1c.	USDA TEXTURE (SURFACE LAYER)	----	HM, MUCK, SP, MPT	FB, PEAT	EXCESS HUMUS
2.	PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<25	25-50	>50	TOO GRAVELLY, TOO COBBLY, OR TOO STONY
3.	AVAILABLE WATER CAPACITY (AVERAGE TO 40") (IN/IN)	>0.15	0.10-0.15	<0.10	DROUGHTY
3a.	(IN)	>6	4-6	<4	
4.	DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
5.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
6.	SOIL MOISTURE REGIME	UDIC, XERIC, USTIC	ARIDIC-XERIC, ARIDIC-USTIC	XERIC-ARIDIC, USTIC-ARIDIC, ARIDIC (TORRIC)	TOO ARID
7.	DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	>3	1.5-3	<1.5	WETNESS
8.	PONDING	NONE	V BRIEF, BRIEF	LONG, V LONG	PONDING

Table 620-46 Grain and Seed Crops for Use as Food and Cover for Wildlife Habitat (continued).

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
9.	FLOODING	NONE, RARE	OCCAS, FREQ, V BRIEF, BRIEF	FREQ, LONG, V LONG	FLOODING
10.	PERMEABILITY (IN/HR) (10-40", SLOWEST LAYER, MIXED, KAOLONITIC MINERALOGY)	>0.2	0.2-0.06	<0.06	PERCS SLOWLY
10a.	PERMEABILITY (IN/HR, 10-40", SLOWEST LAYER, MONTMORILLONITIC MINERALOGY)	≥0.06	<0.06	----	PERCS SLOWLY
11.	SLOPE (PCT)	<15	15-30	>30	SLOPE
12.	SALINITY (MMHOS/CM) (SURFACE LAYER OR 0-20")	<4	4-8	>8	EXCESS SALT
13.	SODIUM ADSORPTION RATIO (SURFACE LAYER) OR (0-20")	<13	13-30	>30	EXCESS SODIUM
14.	EROSION FACTOR (RKLS/T, SURFACE LAYER)	<5	5-8	>8	ERODES EASILY
15.	WIND ERODIBILITY INDEX (CI/T)	<5	5-8	>8	SOIL BLOWING

(c) Irrigated grain and seed crops for use as food and cover for wildlife habitat.

(1) The soil is interpreted as a medium for growing irrigated grain and seed crops, which are a component of specific local habitat requirements for targeted and nontargeted species of wildlife. The purpose of the ratings is to provide guidelines in the selection of soils, sites, and plant species for wildlife habitat and not to reflect commercial agronomic production.

(2) The guide as shown in Table 620.47 is to be used in planning the production of irrigated commercial grain and other seed or vegetative producing annuals for wildlife food and cover. The annual species selected are usually planted at least once each year. Tillage and irrigation during the growing season may increase the potential for soil erosion. To minimize the risk of erosion, the use of conservation practices is required. If appropriate, the soils may receive supplemental fertilization and liming to increase vegetation and seed production. Depending upon the objectives of the manager, the plant species selection and management techniques will dictate whether the habitat will be dominantly used for food, cover, or both. The height and structure of the plant species are important considerations in addressing wildlife cover relationships.

(3) The interpretations provide suitability ratings and identify the dominant soil characteristics that influence the suitability of the site for growing irrigated grain and seed crops.

They allow the manager to plan and develop alternatives in site selection and irrigation system requirements and to select the grain and seed species that best meet the wildlife habitat requirements. The manager is required to develop a list of locally adapted annual cover, grain, and seed species.

(4) Soils that are WELL SUITED have no restrictions to irrigated use and are favorable for locally adapted annual plant species that are used as wildlife habitat. Adapted species may be grown individually or in combination with other adapted species. A SUITED rating implies that the site is suitable for irrigation and the growth of climatically adapted plant species for habitat and that some restrictive features may limit the full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the grain and seed crop as food or cover for wildlife habitat.

(5) The frost-free season is not considered as a rating criterion but is important in making the final selection of local climatically adapted cover, grain, and other annual seed-producing species for wildlife habitat. Carbonates, cation exchange capacity, and reaction (pH) were also not addressed. These properties are found to be too variable between vegetation species. These criteria are better applied at the local level in the final selection of species.

(6) The final selection of a site suitable for irrigation and of annual plant species for use in providing food and cover for wildlife is determined by the limitation of the soil, such as how it influences plant establishment, survival, growth, and vigor. The guide identifies the soil restricting features that will have the most effect on annual plant species as habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Irrigation frequency, planting techniques, seedling emergence, and survival are adversely affected.

1a & 1b--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds are affected. Hard surfaces affect infiltration characteristics and seedling emergence and survival. The infiltration and application rates should be considered in the irrigation system design.

1c--A high content of organic matter, especially the more fiberous materials, directly affects the seedbed preparation and planting and may indirectly affect soil moisture relationships, fertility, subsidence, and the degree of wind erosion.

2--High concentrations of rock fragments adversely affect the use of mechanical equipment in preparing the soil as a seedbed to be planted with grain or other seed-bearing species for habitat. Larger rock fragments also influence the selection of an irrigation system to supplement soil moisture.

3--A low available water capacity means that the ability of the soil to provide moisture to the plants is lower than is desirable for grain and other annual seed crops. Planting drought resistant species minimizes the impact of low available soil moisture and reduces the need for frequent irrigation intervals.

4 & 5--Bedrock or a cemented pan can restrict deep root penetration. Species that have shallow rooting systems adapt better to the site.

6--A seasonal high water table can affect plant growth and survival. It results in poorly aerated soils. Species that are tolerant to wetness are more desirable for establishing wildlife habitat. A seasonal high water table may supplement plant moisture requirements during part of the growing season and irrigation water supplys it during the remainder of the year. The time and length of irrigation application should be monitored to avoid creating a wet soil environment.

7--Ponding or standing water can influence seedbed preparation, seedling emergence, and stand survival during the growing season. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation. The time and length of irrigation application should be adjusted to avoid extending the wet soil environment. Deferred irrigation should be considered.

8--The frequency, timing, and duration of flooding can influence seedbed preparation, seedling emergence, and stand survival. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation. Irrigation systems should be designed to minimize floodwater damage and erosion. Irrigation should be deferred to avoid extending the period of soil saturation.

9 & 9a--The slow movement of water through the soil can cause periodic wet soil conditions which affect seedbed preparation, planting dates, and subsequent plant growth. Selecting species that are tolerant to moderately wet soil conditions may minimize the impact of this limitation. The application rate of irrigation water should be considered in the design of irrigation systems to overcome this limitation, reduce runoff potential, and obtain irrigation efficiency.

10--A steep slope affects soil erosion and the use of mechanical equipment. Maintaining irrigation structures and sprinklers becomes more difficult as the slope increases. If the slope is extreme, it may be better to select an alternative site.

11--Excess water-soluble salts restrict the growth of most plants. They also reduce viable seed germination and seedling survival. The selection and management of plant species that are tolerant of saline conditions can minimize the effect of the salts.

12--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict the growth of plants. Crusting and blocked pores reduce air movement and soil permeability. Soil amendments can sometimes alleviate the problem, but it is often better to select a new site.

13 & 14--A susceptibility to soil erosion requires the implementation of irrigation water management and conservation practices and limits the selection of species to those that will protect the soil from erosive forces.

Table 620-47 Irrigated Grain and Seed Crops for Use as Food and Cover for Wildlife Habitat.

RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. USDA TEXTURE (SURFACE LAYER)	LFS, LVFS, SL, FSL, VFSL, SIL, SI	LCOS, LS, FS, VFS	COS, S	TOO SANDY
1a. USDA TEXTURE (SURFACE LAYER, OXIDIC, KAOLONITIC MINERALOGY	----	C, SIC, SC	----	TOO CLAYEY
1b. USDA TEXTURE (SURFACE LAYER, MIXED, MONTMORILLONITIC MINERALOGY)	----	CL, SICL, SCL	C, SIC, SC	TOO CLAYEY
1c. USDA TEXTURE (SURFACE LAYER)	----	HM, MUCK, SP, MPT	FB, PEAT	EXCESS HUMUS
2. PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<25	25-50	>50	TOO GRAVELLY, TOO COBBLY, OR TOO STONY
3. AVAILABLE WATER CAPACITY (AVERAGE TO 40") (IN/IN) (IN)	>0.15 >6	0.10-0.15 4-6	<0.10 <4	DROUGHTY
4. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
5. DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
6. DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	>3	1.5-3	<1.5	WETNESS
7. PONDING	NONE	V BRIEF, BRIEF	LONG, V LONG	PONDING
8. FLOODING	None, Rare	OCCAS	FREQ	FLOODING

Table 620-47 Irrigated Grain and Seed Crops for Use as Food and Cover for Wildlife Habitat (continued).

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
9.	PERMEABILITY (IN/HR) (10-40", SLOWEST LAYER, MIXED, KAOLONITIC MINERALOGY)	>0.2	0.2-0.06	<0.06	PERCS SLOWLY
9a.	PERMEABILITY (IN/HR, 10-40", SLOWEST LAYER, MONTMORILLONITIC MINERALOGY)	>0.06	<0.06	----	PERCS SLOWLY
10.	SLOPE (PCT)	<4	4-8	>8	SLOPE
11.	SALINITY (MMHOS/CM) (SURFACE LAYER OR 0-20")	<4	4-8	>8	EXCESS SALT
12.	SODIUM ADSORPTION RATIO (SURFACE LAYER OR 0-20")	<13	13-30	>30	EXCESS SODIUM
13.	EROSION FACTOR (RKLS/T, SURFACE LAYER)	<5	5-8	>8	ERODES EASILY
14.	WIND ERODIBILITY INDEX (CI/T)	<5	5-8	>8	SOIL BLOWING

(d) Domestic grasses and legumes for use as food and cover for wildlife habitat.

(1) The soil is interpreted as a medium for growing grasses and legumes, which are a component of specific local habitat requirements for targeted and nontargeted species of wildlife. The purpose of the ratings is to provide guidelines in the selection of soils, sites, and plant species for wildlife habitat and not to reflect commercial agronomic production.

(2) The guide, as shown in Table 620-48, is to be used in planning the production of nonirrigated domestic grass and legume vegetation for wildlife food and cover. The species selected are generally perennial and include some common annuals. They are self-perpetuating after the initial stand establishment and thus will tend to minimize the long-term risk of soil erosion. Tillage may increase the potential for soil erosion during stand establishment, and conservation practices may be required to minimize the hazard. If appropriate, the soils may receive supplemental fertilization and liming to increase vegetation growth rates for the production of vegetative food and cover. Depending upon the objectives of the user, the plant species selection and management techniques will dictate whether the habitat will be dominantly used for food, cover, or both. The height and structure of the vegetation species are important considerations in addressing wildlife cover relationships.

(3) The interpretations provide suitability ratings and identify the dominate soil characteristics that influence the suitability of the site for growing grass and/or legumes. They allow the user to plan and develop alternatives in site selection and to select the grass or legume species, or a combination of both species that best meets the wildlife habitat requirements. The user is required to develop a list of locally adapted domestic grass and legume species.

(4) Soils that are rated WELL SUITED have no use restrictions and are favorable for locally adapted domestic grass and legume species that are used as wildlife habitat. Adapted species may be grown individually or in combination with other adapted species. A SUITED rating implies that the site is suitable for the growth of climatically adapted plants for habitat and that some restrictive features may limit the full potential of plant growth. These conditions may restrict the selection for some of the adapted species to be grown individually or in combination with other adapted species. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of grass and legume species as food or cover for wildlife habitat.

(5) The frost-free season is not considered as a rating criterion, but is important in making the final selection of local climatically adapted grass and legume species for wildlife habitat. Aspect, carbonates, cation exchange capacity, and reaction (pH) were also not addressed. These properties are found to be too variable between vegetation species. These criteria are better applied at the local level in the final selection of species.

(6) The final selection of a site and of suitable domestic grass and legume species for use in providing food and cover for wildlife is determined by the limitation of the soil, such as how it influences plant establishment, survival, growth, and vigor. The guide identifies the soil restricting features that will have the most affect on grass and legume species as habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Planting techniques, seedling emergence, and survival are adversely affected.

1a & 1b--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds are affected. Infiltration characteristics, seedling emergence, and survival are also affected by drying of the surface layer and the formation of surface crusts.

1c--A high content of organic matter, especially the more fibrous materials, affects the seedbed preparation and planting and may indirectly affect soil moisture relationships, fertility, subsidence, and the hazard of wind erosion.

2--High concentrations of rock fragments adversely affect the use of mechanical equipment in preparing the soil as a seedbed to be planted with grass and/or legume species for food or cover. In extreme situations, the use of hand tools is the only alternative.

3--A low available water capacity means that the ability of the soil to provide moisture to plants is lower than is desirable for grass and/or legumes. Although the root systems of grasses and legumes are generally quite extensive, the roots of legumes tend to utilize a deeper portion of the soil profile and thus are more dependent on deep soil moisture. The selection of drought-resistant species minimizes the impact of low available soil moisture.

4 & 5--Bedrock or cemented pans restrict deep root penetration. Species that have shallow root systems adapt better to the site.

6--Soils that are dry most of the time may not recharge soil moisture and sustain legumes, grain, and other annual seed species. Planting drought-resistant grass and legume species may help to overcome this limitation.

7--A seasonal high water table can affect plant growth and survival. It results in poorly aerated soils. Species that are tolerant to wetness are more desirable for establishing wildlife habitat.

8--Ponding or standing water can influence seedbed preparation, seedling emergence, and stand survival during the growing season. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation.

9--The frequency, timing, and duration of flooding can influence seedbed preparation, seedling emergence, and stand survival. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation.

10 & 10a--The slow movement of water through the soil can cause periodic wet soil

conditions, which affect seedbed preparation, planting dates, and subsequent plant growth. Planting species that are tolerant to moderately wet soil conditions minimizes the impact of this limitation.

11--A steep slope affects soil erosion and the use of mechanical equipment. If the slope is extreme, it is may be better to select an alternative site.

12--Excess water-soluble salts restrict the growth of most plants. They also reduce viable seed germination and seedling survival. The management and selection of plant species that are tolerant of saline conditions can minimize the effect of the salts.

13--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict the growth of most plants. Crusting and blocked pores reduce air movement and soil permeability. Soil amendments can sometimes alleviate the problem, but it is often better to select a new site.

14--A susceptibility to soil erosion by water requires the implementation of conservation practices and limits the selection of species to those that will protect the soil from water erosion.

Table 620-48 Domestic Grasses and Legumes for Use as Food and Cover for Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	SL, FSL, VFSL, SIL, SI	LCOS, LS, LFS, LVFS, FS, VFS	COS, S	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER, OXIDIC, KAOLONITIC MINERALOGY	----	C, SIC, SC	----	TOO CLAYEY
1b.	USDA TEXTURE (SURFACE LAYER, MIXED, MONTMORILLONITIC MINERALOGY)	----	CL, SICL, SCL	C, SIC, SC	TOO CLAYEY
1c.	USDA TEXTURE (SURFACE LAYER)	----	HM, MUCK, SP, MPT	FB, PEAT	EXCESS HUMUS
2.	PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<25	25-50	>50	TOO GRAVELLY, TOO COBBLY, OR TOO STONY
3.	AVAILABLE WATER CAPACITY (AVERAGE TO 40") (IN/IN) (IN)	>0.10 >4	0.05-0.10 2-4	<0.05 <2	DROUGHTY
4.	DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
5.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
6.	SOIL MOISTURE REGIME	Udic, Xeric, Ustic	Aridic-Xeric, Aridic-Ustic	Xeric-Aridic, Ustic-Aridic, Aridic (Torric)	TOO ARID
7.	DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	>3	1.5-3	<1.5	WETNESS
8.	PONDING	NONE	V BRIEF, BRIEF	LONG, V LONG	PONDING

Table 620-48 Domestic Grasses and Legumes for Use as Food and Cover for Wildlife Habitat (continued).

RATING CRITERIA		WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
9.	FLOODING	None, Rare	OCCAS, FREQ, V BRIEF, BRIEF	OCCAS, FREQ, LONG, V LONG	FLOODING
10.	PERMEABILITY (IN/HR) (10-40", SLOWEST LAYER, MIXED, KAOLONITIC MINERALOGY)	>0.2	0.2-0.06	<0.06	PERCS SLOWLY
10a.	PERMEABILITY (IN/HR, 10-40", SLOWEST LAYER, MONTMORILLONITIC MINERALOGY)	>0.06	<0.06	----	PERCS SLOWLY
11.	SLOPE (PCT)	<15	15-30	>30	SLOPE
12.	SALINITY (MMHOS/CM) (SURFACE LAYER OR 0-20")	<4	4-8	>8	EXCESS SALT
13.	SODIUM ADSORPTION RATIO (SURFACE LAYER OR 0-20")	<8	8-13	>13	EXCESS SODIUM
14.	EROSION FACTOR (RKLS/T, SURFACE LAYER)	<5	5-8	>8	ERODES EASILY

(e) Irrigated domestic grasses and legumes for use as food and cover for wildlife habitat.

(1) The soil is interpreted as a medium for growing irrigated grasses and legumes, which are as a component of specific local habitat requirements for targeted and nontargeted species of wildlife. The purpose of the ratings is to provide guidelines in the selection of probable soils, sites, and plant species for wildlife habitat and not to reflect commercial agronomic production.

(2) The guide as shown in Table 620-49, is to be used in planning the production of irrigated domestic grass and legume vegetation for wildlife food and cover. The species selected are generally perennial and include some common annuals. They are self-perpetuating after the initial stand establishment and thus tend to minimize the long-term risk of soil erosion. Tillage and irrigation during stand establishment increase the potential for soil erosion. To minimize the risk of erosion, the use of conservation practices is required. If appropriate, the soils may receive supplemental fertilization and liming to increase vegetation growth rates for the production of vegetative food and cover. Depending upon the objectives of the user, the plant species selection and management techniques will dictate whether the habitat will be dominantly used for food, cover, or both. The height and structure of the vegetation species are important considerations in addressing wildlife cover relationships.

(3) The interpretations provide suitability ratings and identify the dominant soil characteristics that influence the suitability of the site for growing irrigated grass and/or legumes. They allow the user to plan and develop alternatives in site selection and irrigation system requirements and to select the grass, or legume species, or a combination of both species that best meets the wildlife habitat requirements. The user is required to develop a list of locally adapted domestic grass and legume species.

(4) Soils that are rated WELL SUITED have no restrictions for irrigated use and are favorable for locally adapted domestic grass and legume species that are used as wildlife habitat. Adapted species may be grown individually or in combination with other adapted species. A SUITED rating implies that the site is suitable for irrigation and the growth of climatically adapted vegetation species for habitat and that some restrictive features may limit the full potential of plant growth. These conditions may restrict the selection for some of the adapted species to be grown individually or in combination with other adapted species. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit irrigation, establishment, growth, maintenance, or performance and thus affect the value of grass and legume species as food or cover for wildlife habitat.

(5) The frost-free season is not considered as a rating criterion, but is important in making the final selection of local climatically adapted grass and legume species for wildlife habitat. Aspect, carbonates, cation exchange capacity, and reaction (pH) were also not addressed. These properties are found to be too variable between vegetation species. These criteria are better applied at the local level in the final selection of species.

(6) The final selection of a site suitable for irrigation and of domestic grass and legume species for use in providing food and cover for wildlife is determined by the limitation of the soil, such as how it influences plant establishment, survival, growth, and vigor. The guide identifies the soil restricting features that will have the most affect on grass and legume species as habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Irrigation frequency, planting techniques, seedling emergence, and survival are affected.

1a & 1b--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds are affected. Hard surfaces affect infiltration characteristics, seedling emergence, and survival. The infiltration and application rates should be considered in the irrigation system design.

1c--A high content of organic matter, especially the more fibrous materials, affects the seedbed preparation and planting and may indirectly affect soil moisture relationships, fertility, subsidence, and the degree of wind erosion.

2--High concentrations of rock fragments adversely affect the use of mechanical equipment in preparing the soil as a seedbed to be planted with grass and/or legume species for habitat. Large rock fragments also influence the selection of an irrigation system to supplement soil moisture.

3--A low available water capacity means that the ability of the soil to provide moisture to plants is lower than is desirable for grass and/or legumes. Although the root systems of grasses and legumes are generally quite extensive, the roots of legumes tend to utilize a deeper portion of the soil profile and thus are more dependent on deep soil moisture. The selection of drought-resistant species minimizes the impact of low available soil moisture and reduces the need for frequent irrigation intervals.

4 & 5--Bedrock or cemented pans restrict deep root penetration. Species that have shallow root systems adapt better to the site.

6--A seasonal high water table can affect plant growth and survival. It results in poorly aerated soils. Species that are tolerant to wetness are more desirable for establishing wildlife habitat. A seasonal high water table may supplement plant moisture requirements during part of the growing season, and irrigation water supply if during the remainder of the year. The time and length of application should be monitored to avoid creating an extended wet soil environment.

7--Ponding or standing water can influence seedbed preparation, seedling emergence, and stand survival during the growing season. Planting species that are tolerant to wet soil conditions minimizes the impact of this limitation. The time and length of irrigation application should be adjusted to avoid extending the wet soil environment. Deferred irrigation should be considered.

8--The frequency, timing, and duration of flooding can influence seedbed preparation, seedling emergence, and stand survival. Selection of species that are tolerant to wet soil conditions minimizes the impact of this limitation. Irrigation systems should be designed to minimize floodwater damage and erosion. Irrigation should be deferred to avoid extending the period of soil saturation.

9 & 9a--The slow movement of water through the soil can cause periodic wet soil conditions which affect seedbed preparation, planting dates, and subsequent plant growth. Selecting species that are tolerant to moderately wet soil conditions minimizes the impact of this limitation. The application rate of irrigation water should be considered in the design of irrigation systems to overcome this limitation, reduce runoff potential, and obtain the maximum irrigation efficiency.

10--A steep slope affects soil erosion and the use of mechanical equipment. Maintaining irrigation structures and sprinklers becomes more difficult as the slope increases. If the slope is extreme, it is may be better to select an alternative site.

11--Excess water-soluble salts restrict the growth of most plants. They also reduce viable seed germination and seedling survival. The management and selection of plant species that are tolerant of saline conditions can minimize the effect of the salts.

12--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict the growth of most plants. Crusting and blocked pores reduce air movement and soil permeability. Soil amendments can sometimes alleviate the problem, but it is often better to select a new site.

13--A susceptibility to water erosion requires the implementation of irrigation water management and conservation practices and limits the selection of species to those that will protect the soil from water erosion.

Table 620-49 Irrigated Domestic Grasses and Legumes for Use as Food and Cover for Wildlife Habitat.

RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. USDA TEXTURE (SURFACE LAYER)	LFS, LVFS, SL, FSL, VFSL, SIL, SI	LCOS, LS, FS, VFS	COS, S	TOO SANDY
1a. USDA TEXTURE (SURFACE LAYER, OXIDIC, KAOLONITIC MINERALOGY	----	C, SIC, SC	----	TOO CLAYEY
1b. USDA TEXTURE (SURFACE LAYER, MIXED, MONTMORILLONITIC MINERALOGY)	----	CL, SICL, SCL	C, SIC, SC	TOO CLAYEY
1c. USDA TEXTURE (SURFACE LAYER)	MUCK, SP	HM, MPT	FB, PEAT	EXCESS HUMUS
2. PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<25	25-50	>50	TOO GRAVELLY, TOO COBBLY, OR TOO STONY
3. AVAILABLE WATER CAPACITY (AVERAGE TO 40") (IN/IN)	>0.10	0.05-0.10	<0.05	DROUGHTY
(IN)	>4	2-4	<2	
4. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
5. DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
6. DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	>3	1.5-3	<1.5	WETNESS
7. PONDING	NONE	V BRIEF, BRIEF	LONG, V LONG	PONDING
8. FLOODING	None, Rare	OCCAS	FREQ	FLOODING

Table 620-49 Irrigated Domestic Grasses and Legumes for Use as Food and Cover for Wildlife Habitat (continued).

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
9.	PERMEABILITY (IN/HR) (10-40", SLOWEST LAYER, MIXED, KAOLONITIC MINERALOGY)	>0.2	0.2-0.06	<0.06	PERCS SLOWLY
9a.	PERMEABILITY (IN/HR, 10-40", SLOWEST LAYER, MONTMORILLONITIC MINERALOGY)	>0.06	<0.06	----	PERCS SLOWLY
10.	SLOPE (PCT)	<4	4-8	>8	SLOPE
11.	SALINITY (MMHOS/CM) (SURFACE LAYER OR 0-20")	<4	4-8	>8	EXCESS SALT
12.	SODIUM ADSORPTION RATIO (SURFACE LAYER OR 0-20")	<13	13-30	>30	EXCESS SODIUM
13.	EROSION FACTOR (RKLS/T, SURFACE LAYER)	<5	5-8	>8	ERODES EASILY

(f) Upland wild herbaceous plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing a diverse upland herbaceous plant community which is adapted to soil conditions that are drier than those common in the moist riparian and wetland zones but that are not as dry as those in the upland desert areas.

(2) These upland herbaceous plant species are predominantly mesophytic and xerophytic and include some hydrophytic plants that are common in areas adjacent to riparian or wetland areas. The adapted vegetation components are selected to meet the specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-50, is intended to provide minimum soil restriction guidelines for the selection of sites for growing and managing herbaceous plants as upland wildlife habitat and not to reflect commercial or livestock grazing values.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing upland wild herbaceous vegetation, either naturally or artificially established. This information allows the user to plan and develop alternatives in site selection and to identify the upland herbaceous plants that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted upland herbaceous species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted upland herbaceous species that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted upland herbaceous species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the upland herbaceous vegetation as wildlife habitat. Existing tree and shrub cover should not influence the ratings.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and reaction (pH). The ability of each species to adapt to these criteria is generally too broad to be considered in this guide. The selection of upland herbaceous species based upon the above rating criteria is more adequately addressed at the local level. In addition, the frequency and duration of flooding or ponding represent soil wetness characteristics necessary to promote the growth of herbaceous hydrophytic vegetation and thus are better addressed in one of the other guides.

(6) The management, reestablishment, or introduction of native upland herbaceous species to provide a diverse vegetation community that meets select wildlife requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the herbaceous species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of upland herbaceous vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds, mechanical use, and large animal hoof impact are affected. Hard surfaces affect seedling emergence and survival. These factors should be considered in selecting alternatives for use and management.

1a--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Seedling emergence and survival are adversely affected.

2--A low available water capacity means that the ability of the soil to provide continual moisture to upland herbaceous plants is lower than is necessary for grasses and forbs to establish or survive naturally. Drought-resistant herbaceous species should be planted or supplemental irrigation should be planned for stand establishment and maintenance.

3--Excess water-soluble salts decrease the moisture available to plants and restrict the growth of most plants. They also reduce species diversity and favor those species that are more tolerant of salts. Salts also reduce viable seed germination and seedling survival. The selection and management of upland herbaceous species that are less sensitive and are tolerant of saline conditions minimize the effect of the salts.

4--Excess exchangeable sodium causes poor soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability and prolong soil wetness. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or to select upland herbaceous species that are tolerant of poor aeration and low water availability.

5--Soils that are dry most of the time may not recharge soil moisture or sustain a diverse upland herbaceous plant community. Planting drought-resistant upland herbaceous species helps to overcome this limitation. Additional moisture provided through irrigation may also be needed to sustain the plant community.

6--A seasonal high water table can affect the establishment, growth, and survival of upland herbaceous vegetation. It results in poorly aerated soils. Upland herbaceous species that are tolerant to wetness are desirable for establishing wildlife habitat.

7--Soil temperatures that are too cold cause permafrost, and soil temperatures that are too cool during the growing season restrict upland herbaceous vegetative growth. The selection of native upland herbaceous species is usually the best alternative for wildlife habitat.

8--A high concentration of rock fragments adversely affects seedbed preparation. Natural regeneration and intensive management that protects and enhances the herbaceous species are the best alternative practices.

Table 620-50 Upland Wild Herbaceous Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	CL, SCL, SICL	SC, SIC, C	TOO CLAYEY
1a.	USDA TEXTURE (SURFACE LAYER)	----	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
2.	AVAILABLE WATER CAPACITY (IN/IN) (AV. TO 40") (IN)	>0.10 >4.0	0.05-0.10 2.0-4.0	<0.05 <2.0	DROUGHTY
3.	SALINITY (MMHOS/CM) (0-20")	<4	4-8	>8	EXCESS SALT
4.	SODIUM ADSORPTION RATIO (0-20")	<8	8-13	>13	EXCESS SODIUM
5.	SOIL MOISTURE REGIME	UDIC, XERIC, USTIC	ARIDIC (TORRIC), USTIC, ARIDIC (TORRIC)-XERIC	ARIDIC (TORRIC), USTIC-ARIDIC (TORRIC), XERIC-ARIDIC (TORRIC)	TOO ARID
6.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>3	1.5-3	<1.5	WETNESS
7.	SOIL TEMPERATURE REGIME	MESIC, FRIGID, THERMIC, HYPER-THERMIC, ISO	CRYIC, PERGELIC (WITH MSST >5° C)	PERGELIC (WITH MSST 2-5° C)	EXTREME SOIL TEMPERATURES
8.	PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH HIGHEST PERCENT)	<50	50-75	>75 TOO COBBLY TOO STONY	TOO GRAVELLY

(g) Desertic herbaceous plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing a diverse desertic herbaceous plant community. The plants are adapted to an arid or semiarid environment that is drier than that common to moist riparian and wetland zones and subhumid, humid, or tropical areas. These upland desertic herbaceous plant species are predominantly xerophytic and include some mesophytic plants that are common along the transitional areas adjacent to riparian or wetland areas.

(2) The adapted vegetation components are selected to meet the specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-51, is intended to provide minimum soil restriction guidelines for the selection of sites for growing and managing desertic herbaceous plants as upland wildlife habitat and not to reflect commercial or livestock grazing values.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing desertic wild herbaceous vegetation, either naturally or artificially established. This information allows the user to plan and develop alternatives in site selection and to identify the desertic herbaceous species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted desertic herbaceous species that are drought resistant. Included in the list are native and introduced species their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted desertic herbaceous species that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted desertic herbaceous species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the desertic herbaceous vegetation as wildlife habitat. Existing tree and shrub cover should not influence the ratings.

(5) Rating criteria not addressed in this guide include aspect, carbonates, and cation exchange capacity. The ability of each species to adapt to these criteria is generally too broad to be considered in this guide. The selection of desertic herbaceous species based upon the above rating criteria is more adequately addressed at the local level. In addition, the frequency and duration of flooding or ponding are not considered as rating criteria. These factors represent soil wetness characteristics necessary to promote the growth of herbaceous hydrophytic vegetation and thus are better addressed in one of the other guides.

(6) The management, reestablishment, or introduction of native desertic herbaceous species to provide a diverse vegetation community that meets select wildlife requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the herbaceous species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of desertic herbaceous vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. Seedling emergence and survival are adversely affected. Selecting or managing the most drought-resistant species as ground cover is the best alternative.

1a--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed and in planting the seeds, mechanical manipulation, and large animal hoof impact are affected. Hard surfaces affect seedling emergence and survival.

2--A low available water capacity means that the ability of the soil to provide continual moisture to desertic herbaceous plants is lower than is necessary for the plants to establish or survive naturally. Drought-resistant herbaceous species should be planted or irrigation should be planned for stand establishment and maintenance.

3--Excess water-soluble salts restrict the growth of most plants. This condition reduces species diversity and favors those species that are more tolerant of salts. Salts also reduce viable seed germination and seedling survival. The selection and management of species that are tolerant of saline conditions minimize the effect of the salts.

4--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability and prolong soil wetness. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or to select desertic herbaceous species that are tolerant of poor aeration and low water availability.

5--Soils that are too alkaline restrict plant growth and species composition. Alkaline soils have low amounts of phosphorus, iron, manganese, baron and zinc available to plants. The addition of soil amendments and/or the selection of species that are tolerant to alkaline conditions are management considerations.

6--Soils that are too moist for desertic plants favor the growth of herbaceous vegetation, which tend to dominant areas of high precipitation by out competing and replacing the desertic species. The result is a reduced diversity of desertic vegetation and its elimination from the plant community. The selection of alternative sites may be the best management alternative.

7--A seasonal high water table can affect the establishment, growth, and survival of desertic herbaceous vegetation. It results in poorly aerated soils. Desertic herbaceous species that are tolerant of soil wetness are more desirable for establishing wildlife habitat.

8--A high concentration of rock fragments affects seedbed preparation. Natural regeneration and intensive management protect and enhance the herbaceous species.

9--Soil temperatures that are too hot or too cold or that are too cool during the growing season restrict the growth of desertic herbaceous vegetation. Native desertic herbaceous species are usually best for wildlife habitat.

Table 620-51 Desertic Herbaceous Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	LCOS, LS, LFS, LVFS, FS, VFS	COS, S	----	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	SIC, C, SC	----	TOO CLAYEY
2.	AVAILABLE WATER CAPACITY (IN/IN) (AV. TO 40") (IN)	>0.05 >2.0	<0.05 <2.0	----	DROUGHTY
3.	SALINITY (MMHOS/CM) (0-20")	<4	4-8	>8	EXCESS SALT
4.	SODIUM ADSORPTION RATIO (0-20")	<13	13-30	>30	EXCESS SODIUM
5.	SOIL REACTION (pH) (0-20")	<8.4	8.4-9.0	>9.0	TOO ALKALINE
6.	SOIL MOISTURE REGIME	ARIDIC (TORRIC), ARIDIC (TORRIC)-USTIC, USTIC-ARIDIC (TORRIC), ARIDIC (TORRIC)-XERIC, XERIC-ARIDIC (TORRIC)	XERIC, USTIC	UDIC	TOO MOIST
7.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>3	1.5-3	<1.5	WETNESS
8.	PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH HIGHEST PERCENT)	<50	50-75	>75	TOO GRAVELLY TOO COBBLY TOO STONY
9.	TEMPERATURE REGIME	FRIGID, MESIC, ISO TEMPERATURES	CRYIC, THERMIC	HYPERTHERMIC	EXTREME SOIL TEMPERATURES

(h) Riparian herbaceous plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing herbaceous plants which are adapted to soil conditions that are wetter than those common in the drier upland areas. The soils suitable for this habitat generally occur along flood plains, depressions, bottom lands, and drainages adjacent to ephemeral, intermittent, or perennial streams. They are either saturated with water for some period during the year or are subject to periodic overflow from ponding or flooding. Stream

scouring and material deposition on flood plains are common. The natural regeneration of many plant species may be dictated by the timing of stream, peak flow events.

(2) These herbaceous plant species are predominantly hydrophytic commonly and include some mesophytic plants. The adapted vegetation components are selected to meet the specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-52, is intended to provide minimum guidelines for the selection of sites for growing and managing herbaceous plants as riparian wildlife habitat and not to reflect commercial or livestock grazing values.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing herbaceous riparian vegetation. This information allows the user to plan and develop alternatives in site selection and to identify the herbaceous riparian species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted herbaceous riparian species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted herbaceous riparian species that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted herbaceous riparian species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the herbaceous riparian vegetation as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and reaction (pH). The ability of each species to adapt to these criteria is generally found to be too variable between adapted riparian herbaceous species. Therefore, species selection based upon the above rating criteria is more adequately addressed at the local level.

(6) The management, reestablishment, or introduction of herbaceous riparian species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the herbaceous species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of herbaceous riparian vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They adversely affect seedling emergence and survival. Within riparian areas, the adverse affects are usually evident when periods of ponding or flooding have ceased and a general lowering of the water table allows the surface layer to dry. The susceptibility to floodwater scouring and the deposition of additional material are indicated by sandy surface layers.

1a--A high content of organic matter affects the suitability of the soil as a seedbed, seedling emergence and survival, and the stability of the soil in resisting flowing water. Soil moisture relationships during dry periods, fertility, subsidence, and plant root characteristics are affected.

2--A seasonal high water table is important to the establishment and growth of herbaceous riparian vegetation. Herbaceous riparian vegetation that is suited to wet soil conditions is adversely affected by dry, well drained soil conditions that do not meet the physiological needs of the adapted species. The selection of species that have root systems that can reach deeper water tables or that are adapted to drier soil conditions is desirable in establishing wildlife habitat. Supplemental irrigation during the growing season may be required for stand establishment and maintenance.

3--Ponding or standing water limits the species composition within existing vegetation communities by reducing species diversity. Standing water influences the time of planting, seedling emergence, plant survival, and the use of any special management techniques during the growing season. The selection and management of herbaceous riparian species that are tolerant to prolonged periods of ponding and saturated soil conditions minimize the limitation.

4--Flooding that occurs annually or more often is desirable for the recharge of flood plain soil and ground water. The timing of flooding and the moisture supplied are essential elements in seedling emergence, community establishment, and continued maintenance of the riparian system. The absence of periodic flooding affects the desirable habitat species. The desired species may not persist and the less desirable species may replace them. The selection of species that are adapted to drier conditions for areas where flooding is minimal is the best alternative for maintaining the vegetation community.

4a--Prolonged flooding results in extended periods of saturated surface soils that limit species composition. Extended periods of flooding cause stream bank erosion, result in channel movement across the flood plain, and open the area to excessive scouring. They influence the time of planting, seedling emergence, plant survival, and the use of any special management techniques during the growing season. The selection and management of herbaceous riparian species that are tolerant to prolonged periods flooding, saturated soil conditions, and high velocities of water flow minimize the impact of this limitation.

5--Excess water-soluble salts restrict the growth of most plants. They reduce viable seed germination and seedling survival. The selection and management of herbaceous riparian species that are tolerant of saline conditions minimize the effect of the salts.

6--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability and prolong soil wetness. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or herbaceous riparian species that are tolerant of poor aeration and low water availability.

7--A high concentration of rock fragments affects seedbed preparation. Natural regeneration and intensive management that protect and enhance the habitat species are the best alternative practices.

8--Soil temperatures that are too cold cause permafrost, and soil temperatures that are too cool during the growing season restrict herbaceous riparian vegetative growth. Local climatically adapted native herbaceous riparian species are usually the best species to select for wildlife habitat.

Table 620-52 Riparian Herbaceous Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	----	MUCK, SP	FB, HM, MPT, PEAT	EXCESS HUMUS
2.	DEPTH TO HIGH WATER TABLE AND (PERCHED APPARENT, FT)	<1	1-3	>3	DEEP TO WATER
3.	PONDING	V BRIEF, BRIEF	LONG	V LONG	PONDING
4.	FLOODING FREQUENCY	FREQ	OCCAS	NONE OR RARE	INFREQUENT FLOODING
4a.	FLOODING DURATION	VERY BRIEF, BRIEF	LONG	V LONG	PROLONGED FLOODING
5.	SALINITY (MMHOS/ CM) (SURFACE LAYER)	<4	4-8	8-16	EXCESS SALT
6.	SODIUM ADSORPTION RATIO (SURFACE LAYER)	<13	13-30	>30	EXCESS SODIUM
7.	PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH HIGHEST PERCENT)	<50	50-75	>75	TOO GRAVELLY TOO COBBLY TOO STONY
8.	SOIL TEMPERATURE REGIME	MESIC, FRIGID, THERMIC, HYPERTHERMIC, ISO TEMPERATURES	CRYIC, PERGELIC (WITH MSST >5° C)	PERGELIC (WITH MSST 2-5° C)	EXTREME SOIL TEMPERATURE

(i) Upland shrubs and vines for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing a diverse upland shrub and vine community. The plants are adapted to soil conditions that are drier than those common in the moist riparian and wetland zones but that are not as dry as those in the upland desert area.

(2) These upland shrub and vine plant species are predominantly mesophytic and xerophytic and include some hydrophytic plants that are common in areas adjacent to riparian or wetland areas. The adapted vegetation components are selected to meet the specific local food and cover habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-53, is intended to provide minimum soil restriction guidelines for the selection of sites for growing and managing upland shrubs and/or vines as wildlife habitat and not to reflect commercial or livestock grazing value.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing upland shrub and/or vine vegetation, either naturally or artificially established. This information allows the user to plan and develop alternatives in site selection and to identify the upland shrubs and vines that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted upland shrub and vine species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no use restrictions and are favorable for all locally adapted upland shrub and vine species that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted upland shrub and vine species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the upland shrub and vine vegetation as wildlife habitat. Existing tree cover should not influence the rating.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and reaction (pH). The ability of each species to adapt to these criteria is generally too broad to be considered in this guide. The selection of upland shrub and vine species based upon the above rating criteria are more adequately addressed at the local level. In addition, the frequency and duration of flooding or ponding represent soil wetness characteristics that are necessary to promote the growth of adapted hydrophytic shrub and vine vegetation and are thus better addressed in one of the other guides.

(6) The management, reestablishment, or introduction of introduced or native upland shrub and vine species to provide a diverse vegetation community that meets select wildlife requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the woody species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of upland shrub and vine vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed, and in seed or mechanical rootstock planting, mechanical manipulation, and large animal hoof impact are affected. Hard surfaces affect infiltration characteristics, seedling emergence, and survival.

1a--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect shallow rootstock, seedling emergence, and survival. Selecting or managing the more drought-resistant species as ground cover is the best alternative.

1b--A high content of organic matter affects the suitability of the soil as a seedbed, the rootstock medium, seedling emergence, and plant survival.

2--A low available water capacity means that the ability of the soil to provide continual moisture to upland shrub and vine vegetation is lower than desirable. A deficiency in soil moisture makes it more difficult for the plants to establish or survive naturally. Drought-resistant shrub and vine species should be selected or supplemental irrigation should be planned for stand establishment and maintenance.

3 & 4--Bedrock or cemented pans restrict the depth of shrub and vine root penetration. Selecting shrub and vine species that have shallow root systems allows full use of the site.

5--Excess water-soluble salts decrease the amount of moisture available to plants and thus restrict the growth of most plants. This condition reduces species diversity and favors those plants that are more tolerant of salts. Salts also reduce viable seed germination and seedling and rootstock survival. The selection and management of upland shrub and vine species that are tolerant of saline conditions minimize the effect of the salts.

6--High concentrations of exchangeable sodium causes poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability and prolong soil wetness. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or select upland shrub and vine species that are tolerant of poor aeration and low water availability.

7--Soil temperatures that are too warm or too cold, that cause permafrost, or that are too cool during the growing season restrict upland shrub and vine vegetative growth. Native upland shrub and vine species are usually the best species to select for wildlife habitat.

8--Soil that is too dry most of the time may not recharge soil moisture or sustain a diverse upland shrub and vine plant community. Selecting drought-resistant upland shrub and vine species helps to overcome this limitation. Supplemental irrigation may also be needed to sustain the plant community.

9--A seasonal high water table can affect the establishment, growth, and survival of upland shrub and vine vegetation. It results in poorly aerated soils. Upland shrub and vine species that are tolerant of soil wetness are desirable for establishing wildlife habitat.

10--A high concentration of rock fragments affects seedbed preparation and mechanical rootstock planting. Natural regeneration and intensive management that protects and enhances the shrub and vine species are the best alternative practices.

Table 620-53 Upland Shrubs and Vines for Use as Wildlife Habitat.

RATING CRITERIA OR PROPERTY	LIMITS			RESTRICTIVE FEATURE
	WELL SUITED	SUITED	POORLY SUITED	
1. USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	CL, SICL, SCL	SIC, C, SC	TOO CLAYEY
1a. USDA TEXTURE (SURFACE LAYER)	LFS, LVFS	LCOS, LS, FS, VFS	COS, S	TOO SANDY
1b. USDA TEXTURE (SURFACE LAYER)	MUCK, SP	HM, MPT	FB, PEAT	EXCESS HUMUS
2. AVAILABLE WATER CAPACITY (IN/IN) (AV. TO 40") (IN)	>0.10 >4.0	0.05-0.10 2.0-4.0	<0.05 <2.0	DROUGHTY
3. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
4. DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
5. SALINITY (MMHOS/CM) (0-20")	<4	4-8	>8	EXCESS SALT
6. SODIUM ADSORPTION RATIO (0-20")	<13	13-30	>30	EXCESS SODIUM
7. SOIL TEMPERATURE REGIME	MESIC, FRIGID, ISO TEMPERATURES	CRYIC, THERMIC	HYPERTHERMIC	EXTREME SOIL TEMPERATURES
8. SOIL MOISTURE REGIME	UDIC, XERIC, USTIC	ARIDIC (TORRIC)-USTIC, ARIDIC (TORRIC)-XERIC	USTIC-ARIDIC (TORRIC), XERIC-ARIDIC (TORRIC), ARIDIC (TORRIC)	TOO ARID
9. DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>3	1.5-3	<1.5	WETNESS
10. PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<50	50-75	>75	TOO GRAVELLY, TOO COBBLY, OR TOO STONY

(j) Upland desertic shrubs and trees for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing a diverse upland desertic shrub community. The plants are adapted to an arid or semiarid environment that is drier than that common to moist riparian and wetland zones and subhumid, humid, or tropical areas. These upland desertic shrub and tree plant species are predominantly xerophytic and include some mesophytic shrubs that are common along transitional areas adjacent to riparian or wetland areas.

(2) The adapted vegetation components are selected to meet the specific local food and cover habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-54, is intended to provide minimum soil restriction guidelines for the selection of sites for growing and managing upland desertic shrubs and trees for wildlife habitat and not to reflect commercial or livestock grazing values.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing desertic shrub vegetation, either naturally or artificially established. This information allows the user to plan and develop alternatives in site selection and to identify the upland desertic shrub and tree species that best meet wildlife habitat requirements. Selection is made from a list of locally adapted upland desertic shrub and tree species that are drought resistant. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no use restrictions and are favorable for all locally adapted upland desertic shrub and tree species that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted upland desertic shrub and tree species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the upland desertic shrub and tree vegetation as wildlife habitat. Existing cover should not influence the ratings.

(5) Ratings criteria not addressed in this guide include aspect, carbonates, and cation exchange capacity. The ability of each species to adapt to these criteria is generally too broad to be considered in this guide. The selection of upland desertic shrub and tree species based upon the above rating criteria is more adequately addressed at the local level. In addition, the frequency and duration of flooding or ponding are not considered as rating criteria. These factors represent soil wetness characteristics necessary to promote the growth of adapted hydrophytic shrub vegetation and thus are better addressed in one of the other guides.

(6) The management, reestablishment, or introduction of introduced or native upland desertic shrub or tree species to provide a diverse vegetation community that meets select wildlife requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the shrub and tree species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of upland desertic shrub or tree vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect shallow rootstock, seedling emergence, and survival. Selecting or managing the most drought-resistant species as ground cover is the best alternative.

1a--Clayey surface layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. Timing and techniques that are used in preparing a seedbed, and in seed or mechanical rootstock planting, mechanical manipulation, and large animal hoof impact are affected. Drying and crusting also affect infiltration characteristics, seedling emergence, and survival.

2--A low available water capacity, as well as the timing and amount of precipitation, relates to the inability of the soil to provide continual moisture to shrubs. A deficiency in soil moisture makes it difficult for the shrubs to establish or survive naturally. Drought-resistant shrub species that have low moisture requirements should be selected or supplemental irrigation should be planned for stand establishment and maintenance.

3--A seasonal high water table can affect the establishment, growth, and survival of upland desertic shrub vegetation. It results in poorly aerated soils. Upland desertic shrub species that are tolerant of soil wetness are desirable for establishing wildlife habitat.

4--Excess water-soluble salts decrease the amount of moisture available to plants, restrict the growth of most plants, reduce species diversity, and favor those species that are more tolerant of salts. They also reduce viable seed germination and seedling and rootstock survival. The selection and management of upland desertic shrub species that are tolerant of saline conditions minimize the effect of the salts.

5--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability and prolong soil wetness. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or upland desertic shrub species that are tolerant of poor aeration and low water availability.

6--Soils that are is too alkaline restrict plant growth and species composition, and the amount of the preferred species may be reduced. Alkaline soils can have low amounts of phosphorous, iron, manganese, boron, and zinc available to plants. The addition of soil amendments and/or the selection of shrub species that are tolerant to alkaline conditions are management considerations.

7--Soil that is too moist most of the time is undesirable for upland desertic shrubs. Other shrub vegetation that requires additional soil moisture tends to dominant areas of high precipitation by competing against and replacing the desertic shrub species. The result is reduced desertic vegetation diversity and the elimination of the upland desertic plant community. Selecting another site may be the best management alternative.

8--Soil temperatures that are too hot or too cold or that are too cool during the growing season restrict the growth of desertic shrub vegetation. Native desertic shrub species are usually the best alternative species to select for wildlife habitat.

9--A high concentration of rock fragments adversely affects seedbed preparation and mechanical rootstock planting. Natural regeneration and intensive management that protects and enhances the shrub species are the best alternative practices.

Table 620-54 Upland Desertic Shrubs and Trees for Use as Wildlife Habitat.

RATING CRITERIA OR PROPERTY	LIMITS WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. USDA TEXTURE (SURFACE LAYER)	---	LCOS, LS, LFS, LVFS, FS, VFS	COS, S	TOO SANDY
1a. USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	SICL, CL, SCL	SIC, C, SC	TOO CLAYEY
2. AVAILABLE WATER CAPACITY (IN/IN)	>0.10	0.05-0.10	<0.05	DROUGHTY
(AV. TO 40") (IN)	>4.0	2.0-4.0	<2.0	
3. DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>5	3-5	<3	WETNESS
4. SALINITY (MMHOS/CM) (0-20")	<4	4-8	>8	EXCESS SALT
5. SODIUM ADSORPTION RATIO (0-20")	<13	13-30	>30	EXCESS SODIUM
6. REACTION (PH) (0-20")	<8.4	8.4-9.0	>9.0	TOO ALKALINE
7. SOIL MOISTURE REGIME	ARIDIC (TORRIC)-USTIC, USTIC-ARIDIC (TORRIC), ARIDIC (TORRIC)-XERIC, XERIC-ARIDIC (TORRIC), ARIDIC (TORRIC)	XERIC, USTIC	UDIC	TOO MOIST
8. SOIL MOISTURE REGIME	FRIGID, MESIC, ISO TEMPERATURES	CRYIC, THERMIC	HYPERTHERMIC	EXTREME SOIL TEMPERATURES
9. PERCENT BY WEIGHT >2MM (SURFACE LAYER, RESTRICTION FRACTION WITH THE HIGHEST PERCENT)	<50	50-75	>75	TOO GRAVELLY, TOO COBBLY, OR TOO STONY

(k) Riparian shrubs, vines, and trees for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing shrubs, vines, and trees that are adapted to soil conditions that are wetter than those common in the drier upland areas. The soils suitable for this habitat generally occur along flood plains, depressions, bottom lands, and areas adjacent to springs and seeps. They are either saturated with water for some period during the year or are subject to periodic overflow from ponding or flooding. The natural regeneration of many species may be dictated by the timing of stream, peak flow events.

(2) These plant species are predominantly hydrophytic and commonly include some mesophytic plants. The adapted vegetation components are selected to meet the specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-55, is intended to provide minimum soil restriction guidelines for the selection of sites for growing and managing riparian shrubs, vines, and trees as wildlife habitat and not to reflect commercial or livestock grazing values.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing woody riparian vegetation. This information allows the user to plan and develop alternatives in site selection and to identify the woody riparian species that best meet the wildlife habitat requirements. The user is required to develop a list of locally adapted woody riparian shrub, vine, and tree species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted woody riparian vegetation that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of climatically adapted woody riparian species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the woody riparian vegetation as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and reaction (pH). These properties are found to be too variable between adapted woody riparian species. Species selection that is based upon the above information is more adequately addressed at the local level. Rock fragment rating criterion also was not addressed. In most cases the woody riparian species can be regenerated naturally or using hand planting techniques with little or no impact to the soil or existing vegetation, or new species can be introduced during optimum planting periods using mechanized methods.

(6) The introduction of woody riparian species or their reestablishment to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the woody species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of woody riparian vegetation as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Soils that have a low available water capacity do not have the ability to provide continuous moisture to woody riparian vegetation. This consideration is especially important if the soil moisture recharge from either a seasonal high water table or overflow sources during the growing season is limited. An available water capacity that is lower than is desirable makes it difficult for woody riparian vegetation to establish or survive naturally. Woody riparian species that have low moisture requirements and that can withstand periodic wet soil conditions should be selected and managed. Supplemental irrigation during dry periods should be planned to ensure stand establishment and maintenance.

2--A seasonal high water table is important for the establishment and growth of woody riparian vegetation. The selection of species that have root systems that can reach deeper water tables or that are adapted to drier soil conditions is desirable in establishing wildlife habitat.

Supplemental irrigation during the growing season may be required for stand establishment and maintenance.

3--Ponding or water standing for prolonged periods can influence the time of planting, seedling emergence and stand survival during the growing season. The selection of woody riparian species that are tolerant to saturated soil conditions and prolonged periods of ponding may minimize the impact of this limitation.

4--Flooding from stream overflow, runoff, or high tides for extended periods adversely affects woody riparian vegetation. Scouring of the surface or deposition result in degradation of existing plant communities. The frequency, timing, and duration of flooding can influence the time of planting, seedling emergence, and stand survival during the growing season. The selection of woody riparian species that are tolerant to prolonged periods of flooding may minimize the impact of this limitation.

5--Excess water-soluble salts decrease the amount of moisture available to plants and restrict the growth of most plants. They reduce viable seed germination and seedling survival. The selection of woody riparian species that are tolerant of saline conditions minimizes the effect of the salts.

6--High concentrations of exchangeable sodium cause poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil permeability. The use of soil amendments can sometimes alleviate the problem, but it is often better to select a new site or select woody riparian species that are tolerant of poor aeration and low water availability.

7--Soil temperatures that are too cold, that cause permafrost, or that are too cool during the growing season restrict woody riparian vegetation growth. Native woody riparian vegetation is usually the best species to select for wildlife habitat.

Table 620-55 Riparian Shrubs, Vines, and Trees for Use as Wildlife Habitat.

RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. AVAILABLE WATER CAPACITY (IN/IN)	>0.08	0.05-0.08	<0-0.05	DROUGHTY
(AV. TO 40") (IN)	>3.2	2.0-3.2	<2.0	
2. DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	<3	3-5	>5	DEEP TO WATER
3. PONDING	NONE	V BRIEF BRIEF	LONG, V LONG	PONDING
4. FLOODING	RARE, FREQ, OCCAS, V BRIEF, BRIEF	FREQ, OCCAS, LONG	FREQ, OCCAS, V LONG	PROLONGED FLOODING
5. SALINITY (MMHOS/CM) (SURFACE LAYER)	<4	4-8	>8	EXCESS SALT
6. SODIUM ADSORPTION RATIO (SURFACE LAYER)	<13	13-24	>24	EXCESS SODIUM
7. SOIL TEMPERATURE REGIME	MESIC, FRIGID, THERMIC, HYPERTHERMIC, ISO TEMPERATURES	CRYIC, PERGELIC (WITH MSST >5° C)	PERGELIC (WITH MSST <5° C)	EXTREME SOIL TEMPERATURES

(l) Upland deciduous trees for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing deciduous trees that meet specific local habitat requirements for targeted and nontargeted species of wildlife. Commonly, deciduous trees are established through natural processes, are seeded, or are transplanted. In general, they require better soil conditions than conifers.

(2) The intent of this guide, as shown in Table 620-56, is to provide minimum soil restriction guidelines for the selection of sites for growing upland deciduous tree species as wildlife habitat and is not to reflect commercial tree growth for timber harvest. In reality, it is not uncommon for the two land use objectives to be met at the same time.

(3) This interpretation guide is of a more general nature. It will provide suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing deciduous trees. It allows the user to plan and develop alternatives in site selection and to identify the adapted tree species that best meet the wildlife habitat requirements. The user is required to develop a list of locally adapted tree species. Included in the list are native or introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted deciduous trees that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the establishment or growth of the trees and that some restrictive features limit its full potential. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the deciduous trees as wildlife habitat.

(5) Rating criteria not addressed in this guide are aspect, carbonates, cation exchange capacity, reaction (PH), salinity, and sodicity. These properties are found to be too variable between adapted deciduous tree species and are better addressed independently at the local level when making the final selection of species.

(6) The introduction or reestablishment of deciduous trees to meet select wildlife habitat requirements is determined by a number of factors. These factors are landscape, climate, soil, vegetation, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of a tree stand. The guide addresses only those factors that relate primarily to the soil.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Soils that have a low available water capacity do not have the ability to provide continual moisture to deciduous trees. This condition makes it more difficult for trees to establish or survive naturally. Drought-resistant deciduous tree species that have low moisture requirements should be selected or supplemental irrigation should be planned for stand establishment and maintenance.

2--A seasonal high water table can affect tree growth and survival. It results in poorly aerated soils. The selection of deciduous tree species that are tolerant of soil wetness is desirable for establishing wildlife habitat.

3 & 4--Bedrock or cemented pans restrict the depth of tree root penetration and thus limit the growth potential of the trees. These conditions result in windthrow and have other adverse affects on stand performance. Selecting deciduous tree species that have shallow root systems allows full utilization of the site.

5--Soil that is dry most of the time may not recharge soil moisture or sustain deciduous trees during the normal growing season. Selecting drought-resistant deciduous tree species helps to overcome this limitation. Supplemental moisture from irrigation may be necessary to provide water for tree establishment and maintenance.

6--Soil temperatures that are too cold, that cause permafrost, or that are too cool during the growing season restrict tree growth. Native trees are usually the best deciduous tree species to select and manage for wildlife habitat.

Table 620-56 Upland Deciduous Trees for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	AVAILABLE WATER CAPACITY (IN/IN)	>0.10	0.05-0.10	<0.05	DROUGHTY
	(AV. TO 40") (IN)	>4.0	2.0-4.0	<2.0	
2.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>5	3-5	<3	WETNESS
3.	DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
4.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
5.	SOIL MOISTURE REGIME	UDIC, XERIC	USTIC	ARIDIC (TORRIC), ARIDIC (TORRIC)-USTIC, ARIDIC (TORRIC)- XERIC	TOO ARID
6.	SOIL TEMPERATURE REGIME	MESIC, FRIGID, THERMIC, HYPERTHERMIC, ISO TEMPERATURES	CRYIC, PERGELIC (WITH MSST > 5° C)	PERGELIC (WITH MSST <5° C)	EXTREME SOIL TEMPERATURES

(m) Upland coniferous trees for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing upland coniferous trees that meet specific local habitat requirements for targeted and nontargeted species of wildlife. The species include low stature conifers, such as yew and juniper. Baldcypress is not included for interpretations use in this guide due to its unique water and soil moisture requirements. Commonly, upland conifer trees are established through natural processes, are seeded, or are transplanted. Many species of conifers often grow in soil conditions that are harsher than those required for hardwoods.

(2) The guide, as shown in Table 620-57, is intended to provide minimum soil restriction guidelines for the selection of sites for growing upland coniferous trees as wildlife habitat and not to reflect commercial tree growth for timber harvest. In reality, it is not uncommon for the two land use objectives to be met at the same time.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing coniferous trees. This information allows the user to plan and develop alternatives in site selection and to identify the adapted tree species that best meet the wildlife habitat requirements. The user is required to develop a list of locally adapted tree species. Included in the list are native or introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted coniferous trees that are used as wildlife habitat. A SUITED rating implies that the site is suitable for the growth of climatically adapted coniferous trees for habitat and that some restrictive features limit its full potential. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the coniferous trees as wildlife habitat.

(5) Rating criteria not addressed in this guide are aspect, carbonates, cation exchange capacity, reaction (pH), salinity, and sodicity. These properties are found to be too variable between adapted conifer tree species and are better addressed independently at the local level when making the final selection of species. In addition, the frequency and duration of flooding or ponding are not considered as rating criteria. Coniferous tree species, such as the baldcypress, that have specific water requirements can easily be handled in one of the other guides.

(6) The introduction or reestablishment of coniferous trees to meet select wildlife habitat requirements is determined by a number of factors. These factors are landscape, climate, soil, vegetation, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of a tree stand. The guide addresses only those factors that relate primarily to the soil.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Soils that have a low available water capacity do not have the ability to provide continual moisture to coniferous trees. This condition makes it difficult for trees to establish or survive naturally. Drought-resistant coniferous tree species that have low moisture requirements should be selected or supplemental irrigation should be planned for stand establishment and maintenance.

2--A seasonal high water table adversely affects tree growth and survival. It results in poorly aerated soils. The selection of coniferous species that are tolerant of soil wetness is desirable for establishing wildlife habitat.

3 & 4--Bedrock or cemented pans restrict the depth of tree root penetration and thus limit the growth potential of the trees. These conditions result in windthrow and have other adverse affects on stand performance. Selecting coniferous tree species that have shallow root systems allows full utilization of the site.

5--Soil that is dry most of the time may not recharge soil moisture or sustain coniferous trees during the normal growing season. Selecting of drought-resistant coniferous tree species helps to overcome this limitation. Supplemental moisture from irrigation may be necessary to provide water for tree establishment and maintenance.

6--Soil temperatures that are too hot or too cold, that cause permafrost, or that are too cool during the normal growing season restrict tree growth. Native trees are usually the best coniferous tree species to select and manage for wildlife habitat.

Table 620-57 Upland Coniferous Trees for Use as Wildlife Habitat.

RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. AVAILABLE WATER CAPACITY (IN/IN)	>0.08	0.05-0.08	<0.05	DROUGHTY
(AV. TO 40") (IN)	>3.2	2.0-3.2	<2.0	
2. DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>3.5	1.5-3.5	<1.5	WETNESS
3. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
4. DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
5. SOIL MOISTURE REGIME	UDIC, XERIC, USTIC	ARIDIC (TORRIC)-USTIC, ARIDIC (TORRIC)- XERIC	USTIC-ARIDIC (TORRIC), XERIC-ARIDIC (TORRIC), ARIDIC (TORRIC)	TOO ARID
6. SOIL TEMPERATURE REGIME	MESIC, FRIGID, CRYIC, ISOMESIC	THERMIC PERGELIC (WITH MSST >5° C), ISOTHERMIC	HYPERTHERMIC, PERGELIC (WITH MSST <5° C), ISOHYPER-THERMIC	EXTREME SOIL TEMPERATURES

(n) Freshwater wetland plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing wetland herbaceous vegetation and shrubs that are adapted to wet soil conditions. Floating or submerged aquatics are excluded from use in this guide. The soils suitable for this habitat generally occur adjacent to springs, seeps, depressions, bottom lands, marshes, or the backwater areas of flood plains, such as oxbow lakes, that are not directly affected by moving floodwaters. Many areas are ponded for some period of time because of the accumulation of excessive moisture caused by runoff from the surrounding area.

(2) These plant species are predominantly hydrophytic and commonly include some mesophytic plants. The regeneration of plant species is normally through natural progression. The introduction of exotic species to enhance the habitat is an infrequent occurrence usually due to wet soil conditions during the period of optimum planting. Generally, management is better directed towards enhancing or propagating existing species that are adapted to the soil conditions of the site and that meet a desired habitat need. The adapted vegetation components are selected to meet specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-58, is intended to provide minimum guidelines for the selection of sites for growing freshwater wetland plants as wildlife habitat and not to reflect commercial or livestock grazing values.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing freshwater wetland vegetation. This information allows the user to identify the freshwater wetland species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted wetland species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted freshwater wetland vegetation that are used as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted freshwater wetland species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the freshwater wetland vegetation as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, and cation exchange capacity. The adaptability of each species to these criteria is generally too broad to be considered in this guide. Therefore, species selection based upon the above rating criteria is more adequately addressed at the local level.

(6) The criteria of slope, rock fragments, and soil temperature regime were also not addressed. In most cases plant species may be regenerated and maintained naturally with little or no impact to the soil or existing vegetation, or new species may be introduced during optimum planting periods by mechanized or other methods.

(7) The management, reestablishment, or introduction of freshwater wetland species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the freshwater wetland species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of freshwater wetland plants as wildlife habitat.

(8) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect seedling emergence and survival, especially after ponding and a lowering of the seasonal high water table.

1a--A high content of organic matter affects the suitability of the soil as a seedbed, and seedling emergence and survival. Also affected are soil moisture relationships during dry periods, fertility, subsidence, and plant root characteristics.

2--Soils that are deep to a water table adversely affect the establishment and growth of wetland plant vegetation. This condition is especially critical for shallow rooted species. The management or selection of species that have deep root systems or that are adapted to drier soil conditions is desirable for establishing wildlife habitat. Supplemental irrigation during the growing season may be required for stand maintenance.

3--Ponding or standing water results in extended periods of saturated surface soils. The time and duration of standing water can influence seedling emergence and plant survival during the growing season. The selection and management of freshwater wetland species that are tolerant to saturated soil conditions and prolonged periods of ponding may minimize the impact of this limitation.

4--Excess water-soluble salts decrease the amount of moisture available to plants and restrict the growth of the more desirable freshwater wetland species. They reduce viable seed germination and seedling survival. As a result of natural species selection and management, the more desirable freshwater wetland species may decrease in abundance and the less desirable salt-tolerant plants increase.

5--A high concentration of exchangeable sodium causes poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce soil air movement and soil permeability. The use of soil amendments can sometimes alleviate the problem, but natural species selection and management may still tend to promote the less desirable species that are tolerant to poor aeration rather than the preferred freshwater wetland vegetation. It is often better to select a new site.

6--Soils that are too acid restrict plant growth, species composition, and the amount of preferred species. Acid soils generally contain sulfuric acid, have low base saturation, and have the potential for aluminum and/or manganese toxicity. The addition of soil amendments and/or the selection of species that are tolerant to acid conditions are management considerations.

6a--Soils that are too alkaline restrict plant growth, species composition, and the amount of preferred species. They usually have low amounts of phosphorus, iron, manganese, boron, and zinc available to plants. The addition of soil amendments and/or the selection of species that are tolerant to alkaline conditions are management considerations.

Table 620-58 Freshwater Wetland Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	FS, VFS	COS, S, SG	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	MUCK, SP	FB, PEAT, HM, MPT	----	EXCESS HUMUS
2.	DEPTH TO HIGH WATER TABLE (PERCHED AND APPARENT, FT)	<1	1-3	>3	DEEP TO WATER
3.	PONDING	V BRIEF, BRIEF, LONG	V LONG	----	PONDING
4.	SALINITY (MMHOS/CM) (SURFACE LAYER)	<2	2-4	>4	EXCESS SALT
5.	SODIUM ADSORPTION RATIO (SURFACE LAYER)	<8	8-13	>13	EXCESS SODIUM
6.	SOIL REACTION (PH) (0-40")	6.0-8.4	4.5-6.0	<4.5	TOO ACID
6a.	SOIL REACTION (PH) (0-40")	----	----	>8.4	TOO ALKALINE

(o) Irrigated freshwater wetland plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing wetland herbaceous vegetation and shrubs that are adapted to wet soil conditions. Floating or submerged aquatics are excluded from use in this guide. The purpose of the guide is to identify soils that have the best probability for success in maintaining the existing, naturally established marginal wetlands or in establishing new wetlands, including mitigation to replace existing wetlands. It is accomplished through management practices for irrigation water and vegetation. The soils suitable for this habitat generally occur in areas of cropland, previously cropped areas, and odd or marginal areas associated with cropland and wetlands. Some areas may be subject to ponding for indefinite periods because of the accumulation of excessive moisture caused by runoff from the surrounding area.

(2) The plant species are predominantly hydrophytic and include some mesophytic plants that commonly occur on wetland sites. The adapted vegetation components are selected to meet specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-59, is intended to provide minimum guidelines for the selection of probable sites for the irrigation and management of freshwater wetland plants as wildlife habitat and not to reflect commercial or livestock grazing values.

(3) The guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for irrigating and growing herbaceous vegetation and shrubs. This information allows the user to identify the sites that have the best potential for establishing freshwater species that best meet the wildlife habitat requirements. Plant selection is made from a list of locally adapted wetland species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use as an irrigated wetland site and are favorable for all locally adapted freshwater herbaceous vegetation and shrubs that are used as wildlife habitat. A SUITED rating implies that the irrigated site is suitable and is favorable for the establishment or growth of climatically adapted freshwater wetland species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit the establishment, growth, maintenance, or performance of irrigated wetland and thus affect the value of the freshwater wetland herbaceous vegetation and shrubs as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and soil temperature regime. The adaptability of each species to these criteria is generally too broad to be considered in this guide. Therefore, species selection based on the above rating criteria are more adequately addressed at the local level.

(6) The management, reestablishment, or introduction of freshwater herbaceous vegetation and shrubs to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the freshwater wetland plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect seedling emergence and survival, most commonly between periods of irrigation.

1a--A high content of organic matter affects the suitability of the soil as a seedbed, and seedling emergence and survival. Also affected are soil moisture relationships during dry periods, fertility, subsidence, and plant root characteristics.

2--Soils that are deep to a water table adversely affect wetland plants, site selection, and the establishment and growth of vegetation. Soil that have a seasonal high water table are desirable because in these areas irrigation water and irrigation frequency needed to maintain wetland conditions are reduced. Freshwater wetland species that are suited to wet soil conditions are adversely affected by dry soil conditions. These conditions are especially critical for shallow rooted species. The management of irrigation water and the selection of species that are adapted to drier soil conditions help to overcome this limitation.

3--Ponding or standing water results in extended periods of saturated surface soils which influence seedling emergence and plant survival during the growing season. The selection and management of freshwater wetland species that are tolerant to saturated soil conditions and ponding minimize the impact of this limitation.

4--Excess water-soluble salts decrease the amount of moisture available to plants and restrict the growth of the more desirable species. They reduce viable seed germination and seedling survival. As a result of natural species selection and management, the more desirable freshwater wetland species may decrease in abundance and the less desirable salt-tolerant plants increase.

5--A high concentration of exchangeable sodium causes poor physical soil conditions that restrict plant growth. Crusting and blocked pores reduce air movement and soil permeability. Soil amendments can sometimes alleviate the problem, but natural species selection and management may still tend to promote the less desirable species that are tolerant to poor aeration rather than the preferred freshwater wetland vegetation. It is often better to select a new site.

6--Because of slope, some sites may require special practices to ensure a satisfactory freshwater wetland wildlife habitat. If irrigation is a necessary requirement for maintaining adequate wetland vegetation, the use of borders, contour terraces, etc. are also required to maintain water control. The maintenance of structures becomes more difficult as the slope increases. The potential for soil erosion also increases. If slope is extreme, it may be better to select an alternative site.

7--Permeability that allows an excessive movement of water through the soil is undesirable. Permeability that maintains wet soil conditions for extended periods, which are necessary for the growth and maintenance of wetland herbaceous vegetation and shrubs, is desired.

8--Soils that are too acid restrict plant growth, species composition, and the amount of preferred species. Acid soils generally contain sulfuric acid, have low base saturation, and have the potential for aluminum and/or manganese toxicity. The addition of soil amendments and/or the selection of species that are tolerant to acid conditions are management considerations.

8a--Soils that are too alkaline restrict plant growth, species composition, and the amount of preferred species. They usually have low amounts of phosphorus, iron, manganese, boron, and zinc available to plants. The addition of soil amendments and/or the selection of species that are tolerant to alkaline conditions are management considerations.

Table 620-59 Irrigated Freshwater Wetland Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	MUCK, SP	FB, HM, MPT	PEAT	EXCESS HUMUS
2.	DEPTH TO HIGH WATER TABLE (PERCHED AND APPARENT, FT)	<3	3-5	>5	DEEP TO WATER
3.	PONDING	V BRIEF, BRIEF, LONG	V LONG	----	PONDING
4.	SALINITY (MMHOS/CM) (SURFACE LAYER)	<2	2-4	>4	EXCESS SALT
5.	SODIUM ADSORPTION RATIO (SURFACE LAYER)	<8	8-13	>13	EXCESS SODIUM
6.	SLOPE (PCT)	<3	3-8	>8	SLOPE
7.	PERMEABILITY (IN/HR) (0-40")	<0.2	0.2-6.0	>6.0	SEEPAGE
8.	SOIL REACTION (PH) (0-40")	6.0-8.4	4.5-6.0	<4.5	TOO ACID
8a.	SOIL REACTION (PH) (0-40")	----	----	>8.4	TOO ALKALINE

(p) Saline water wetland plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing saline-tolerant wetland herbaceous vegetation and shrubs that are adapted to wet soil conditions. Floating or submerged aquatics are excluded from use in this guide. The soils suitable for this habitat generally occur in saline-sodic affected areas adjacent to springs, seeps, depressions, bottom lands, and marshes or in the backwater areas of flood plains, such as oxbow lakes, that are not directly affected by moving floodwaters. Many areas are ponded for some period of time because of the accumulation of excessive moisture caused by runoff from the surrounding area.

(2) These plant species are predominantly hydrophytic and commonly include some mesophytic plants. The regeneration of plant species is normally through natural progression. The introduction of exotic species to enhance the habitat is an infrequent occurrence usually due to wet soil conditions during the period of optimum planting.

Generally, management is better directed towards enhancing or propagating existing species that are adapted to the saline-sodic soil conditions of the site and that meet a desired habitat need. The adapted vegetation components are selected to meet specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-60, is intended to provide minimum guidelines for the selection of saline sites for growing and managing saline-tolerant herbaceous vegetation and shrubs as wildlife habitat and not to reflect commercial or livestock grazing values.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing saline water wetland vegetation. This information allows the user to identify saline-tolerant wetland species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted wetland species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted saline-tolerant wetland vegetation that are used as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted saline-tolerant wetland species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance of plants and thus affect the value of the saline-tolerant wetland vegetation as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, and cation exchange capacity. The adaptability of each species to these criteria is generally too broad to be considered in this guide. Therefore, species selection based upon the above rating criteria is more adequately addressed at the local level. The criteria of slope, rock fragments, and soil temperature regime were also not addressed. In most cases plant species may be regenerated or maintained naturally with little or no impact to the soil or existing vegetation, or new species may be introduced during optimum planting periods by mechanized or other methods.

(6) The management, reestablishment, or introduction of saline-tolerant wetland species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of saline-wetland species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of saline-tolerant wetland plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect seedling emergence and survival.

1a--A high content of organic matter affects the suitability of the soil as a seedbed and seedling emergence and survival. Also affected are soil moisture relationships during dry periods, fertility, subsidence, and plant root characteristics.

2--Soils that are deep to a water table adversely affect the establishment and growth of wetland plants. Desirable saline-tolerant wetland vegetation is adapted to wet soil conditions. The management or selection of species that have deep root systems or that are adapted to drier soil conditions is more desirable. Supplemental irrigation during the growing season may be required for stand maintenance.

3--Ponding or standing water results in extended periods of saturated surface soils. The time and duration of standing water can influence seedling emergence and plant survival during the growing season. The selection and management of saline water wetland species that are tolerant to saturated soil conditions and ponding may minimize the impact of this limitation.

4--Soils that have low concentrations of water soluble salts are not favorable to saline-tolerant species but are favorable to the growth and competition of species that are less tolerant of water-soluble salts. This condition results in a reduction in the kind, amount, and proportion of desirable saline-tolerant species. As a result of natural species selection and management of these sites, the desirable saline water wetland species may decrease in abundance and the less desirable freshwater wetland plants increase.

5--A high concentration of exchangeable sodium causes poor physical soil conditions that help to maintain saline-tolerant vegetation communities. Crusting and blocked pores restrict soil air movement and soil permeability. These soil conditions reduce plant competition from the less saline-tolerant species.

6--Soils that are too acid restrict plant growth, species composition, and the amount of preferred species. Acid soils generally contain sulfuric acid, have low base saturation, and have the potential for aluminum and/or manganese toxicity. The addition of soil amendments and/or the selection of species that are tolerant to acid conditions are management considerations.

6a--Soils that are too alkaline restrict plant growth, species composition, and the amount of preferred species. They usually have low amounts of phosphorus, iron, manganese, boron, and zinc available to plants. The addition of soil amendments and/or the selection of species that are tolerant to alkaline conditions are management considerations.

Table 620-60 Saline Water Wetland Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	FS, VFS	COS, S, SG	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	MUCK, SP	FB, HM, MPT, PEAT	----	EXCESS HUMUS
2.	DEPTH TO HIGH WATER TABLE (PERCHED AND APPARENT, FT)	<1	1-3	>3	DEEP TO WATER
3.	PONDING	V BRIEF, BRIEF, LONG	V LONG	----	PONDING
4.	SALINITY (MMHOS/CM) (SURFACE LAYER)	>8	4-8	<4	LOW SALT
5.	SODIUM ADSORPTION RATIO (SURFACE LAYER)	>30	13-30	<13	LOW SODIUM
6.	SOIL REACTION (PH) (SURFACE LAYER)	6.0-9.0	4.5-6.0	<4.5	TOO ACID
6a.	SOIL REACTION (PH) (SURFACE LAYER)	----	----	>9.0	TOO ALKALINE

(q) Irrigated saline water wetland plants for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing saline-tolerant wetland herbaceous vegetation and shrubs that are adapted to wet soil conditions. Floating or submerged aquatics are excluded from use in this guide. The purpose of the guide is to identify soils that have the best probability for success in maintaining the existing, naturally established, saline water marginal wetlands or in establishing new saline water wetlands, including mitigation to replace existing wetlands. It is accomplished by managing irrigation water and by planting saline-tolerant vegetation. The soils suitable for this habitat generally occur in saline-sodic affected areas of cropland, previously cropped areas, odd areas associated with cropland, wildlands, and marginal areas associated with existing wetlands that are not directly affected by moving floodwaters. Not included are sites that are wet due to past irrigation and management practices. Some areas may be subject to ponding for indefinite periods because of the accumulation of excessive moisture caused by runoff from the surrounding area.

(2) The plant species are predominantly hydrophytic and include some mesophytic plants that commonly occur on wetland sites. The adapted vegetation components are selected to meet specific local habitat requirements for targeted and nontargeted species of wildlife. The guide, as shown in Table 620-61, is intended to provide minimum guidelines for the selection of probable sites for the irrigation and management of saline-tolerant herbaceous vegetation and shrubs as wetland wildlife habitat and not to reflect commercial or livestock grazing values.

(3) The guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for irrigating and growing saline-tolerant herbaceous vegetation and shrubs.

This information allows the user to identify the sites that have the best potential for establishing saline-tolerant species that best meet the wildlife habitat requirements. Plant selection is made from a list of locally adapted wetland species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions for growing saline-tolerant wetland herbaceous vegetation and shrubs as wildlife habitat. A SUITED rating implies that the irrigated site is suitable and favorable for the establishment or growth of climatically adapted saline tolerant wetland species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit the establishment, growth, maintenance, or performance of irrigated plants and thus affect the value of the saline-tolerant wetland herbaceous vegetation and shrubs as wildlife habitat.

(5) Rating criteria not addressed in this guide include aspect, carbonates, cation exchange capacity, and soil temperature regime. The adaptability of each species to these criteria is generally too broad to be considered in this guide. Therefore, species selection based on the above rating criteria is more adequately addressed at the local level.

(6) The management, reestablishment, or introduction of saline-tolerant herbaceous vegetation and shrubs to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the saline water wetland plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Sandy surface layers are soft and loose, droughty, and generally low in fertility. They affect seedling emergence and survival, most commonly between periods of irrigation.

1a--A high content of organic matter directly affects the suitability of the soil as a seedbed and seedling emergence and survival. Also affected are soil moisture relationships during dry periods, fertility, subsidence, and plant root characteristics.

2--Soils that are deep to a water table adversely affect wetland plants, site selection, and the establishment and growth of vegetation. Soils that have a seasonal high water table are more desirable in these areas because irrigation water and irrigation frequency can be reduced. Saline-tolerant wetland species that are suited to wet soil conditions are adversely affected by dry soil conditions. These conditions are especially critical for shallow rooted species. The management of irrigation water and the selection of saline-tolerant species that are adapted to drier soil conditions help to overcome this limitation.

3--Ponding or standing water results in extended periods of saturated surface soils, which influence seedling emergence and plant survival during the growing season. The selection and management of saline-tolerant wetland species that are adaptable to saturated soil conditions and ponding minimize the impact of this limitation.

4--Low concentrations of water-soluble salts cause site conditions that are unfavorable to saline-tolerant species but are favorable to the growth of and the competition from other species. These conditions result in a reduction in the kind, amount, and proportion of desirable saline-tolerant species. As a result of natural species selection and management of these sites, the more desirable saline water wetland species may decrease in abundance, and the less desirable freshwater wetland plant increase.

5--A high concentration of exchangeable sodium causes poor physical soil conditions that help to maintain saline-tolerant vegetation communities. Crusting and blocked pores restrict soil air movement and soil permeability. These conditions reduce plant competition from the less saline-tolerant species.

6--Because of slope, some sites may require special practices to ensure a satisfactory saline water wetland wildlife habitat. If irrigation becomes a necessary requirement for maintaining adequate wetland vegetation, the use of borders, contour terraces, etc. are also required to maintain water control. The maintenance of structures is more difficult as the percent of slope increases. The potential for soil erosion also increases. If slope is extreme, it may be better to select an alternative site.

7--Permeability that allows an excessive movement of water through the soil is desirable.

Permeability that maintains wet soil conditions for extended periods, which are necessary for the growth and maintenance of saline-tolerant wetland herbaceous vegetation and shrubs, is desired.

8--Soils that are too acid restrict plant growth, species composition, and the amount of preferred species. Acid soils generally contain sulfuric acid, have low base saturation, and have the potential for aluminum and/or manganese toxicity. The addition of soil amendments and/or the selection of species that are tolerant to acid conditions are management considerations.

8a--Soils that are too alkaline restrict plant growth, species composition, and the amount of preferred species. They have low amounts of phosphorus, iron, manganese, boron, and zinc available to plants. The addition of soil amendments and/or the selection of species that are tolerant to alkaline conditions are management considerations.

Table 620-61 Irrigated Saline Water Wetland Plants for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	USDA TEXTURE (SURFACE LAYER)	ALL OTHER TEXTURES	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	TOO SANDY
1a.	USDA TEXTURE (SURFACE LAYER)	MUCK, SP, MPT	HM, MPT	FB, PEAT	EXCESS HUMUS
2.	DEPTH TO HIGH WATER TABLE (PERCHED AND APPARENT, FT)	<3	3-5	>5	DEEP TO WATER
3.	PONDING	V BRIEF, BRIEF, LONG	V LONG	----	PONDING
4.	SALINITY (MMHOS/CM) (SURFACE LAYER)	>8	4-8	<4	LOW SALT
5.	SODIUM ADSORPTION RATIO (SURFACE LAYER)	>30	13-30	<13	LOW SODIUM
6.	SLOPE (PCT)	<3	3-8	>8	SLOPE
7.	PERMEABILITY (IN/HR) (0-40")	<0.2	0.2-6.0	>6.0	SEEPAGE
8.	SOIL REACTION (PH) (SURFACE LAYER)	6.0-9.0	4.5-6.0	<4.5	TOO ACID
8a.	SOIL REACTION (PH) (SURFACE LAYER)	----	----	>9.0	TOO ALKALINE

(r) Sedge-grass tundra for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing sedge-grass tundra vegetation that is adapted to cold and wet soil conditions throughout the growing season. Floating or submerged aquatics are excluded from use in this guide. The soils suitable for this habitat are normally perennially frozen at shallow depths and are wet throughout the summer. They generally occur in areas of excess water, depressions, and side slopes affected by seepage. These areas may be found along coastlines, coastal lowlands, hills, foothills, ridges, mountains, and sometimes dunes. Many areas are ponded for some period of time because of the spring thaw or the accumulation of excessive moisture caused by runoff from the surrounding areas.

(2) These perennial and annual grasslike species, grasses, and lichen species are water tolerant. They are predominantly hydrophytic and include some mesophytic plants. The regeneration of plant species is normally through natural progression. Therefore, the plant species are usually native to the area. At the present time, there is minimal or no human influence, such as by the introduction of exotic species. Management is designed to return degraded areas to their potential or to maintain or increase the present vegetative cover and protect the vegetation from the impact of wildfires. A reduction of sedge-grass cover by animal, human, or wildfire interference opens the soil to increased thermal heating. This condition can cause a general lowering of the permafrost and the water table and thus result in potentially drier soil. The result is that the effect of the water table on adapted plant species is reduced. Such a situation can initiate a successional change in the vegetation community from the more desirable, water-tolerant sedge-grass species to a drier, woody shrub-moss dominated vegetation community. The guide, as shown in Table 620-62, is intended to provide minimal guidelines for the identification and selection of potential sites for growing sedge-grass tundra as wildlife habitat.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing sedge-grass tundra vegetation. This information allows the user to identify the sedge-grass species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted sedge-grass species. Included in the list are native and introduced species, their suitability rating, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted sedge-grass vegetation as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted sedge-grass species for habitat and that some restrictive features limit their full potential for plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the sedge-grass vegetation as wildlife habitat.

(5) A number of rating criteria are not addressed in this guide because of the lack of available information about the effect of other soil properties on sedge-grass communities. As new information is available, rating criteria will be added to future updates of this guide.

(6) In most cases plant species may be regenerated and maintained naturally with little or no impact to the soil or existing vegetation by mechanical or other means. The management and reestablishment of sedge-grass tundra species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the sedge-grass tundra species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of sedge-grass tundra plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Soils that are deep to a water table adversely affect the establishment and growth of sedge-grass tundra vegetation. Desirable sedge-grass vegetation is adapted to wet soil conditions, especially if it is shallow rooted species. The management or selection of species that have root systems that can reach deep water tables or that are adapted to drier soil conditions is desirable.

2--Soils that are deep to permafrost restrict sledge-grass tundra plants and affect their establishment and maintenance. Most of these plants are shallow rooted and are dependent upon the permafrost to perch and maintain a water table at or near the soil surface during the growing season. Lower or deeper permafrost layers cause associated water tables to decrease in depth. The result is periodic drying and warming of the soil. Thus other species are allowed to invade the site and ultimately replace the desired sedge-grass tundra species. Management should include maintaining or raising the permafrost and any associated water table to desirable levels.

3--Soil temperatures that are too warm during the growing season restrict sedge-grass tundra vegetative growth. Local climatically adapted native species are usually the best alternative species to select for wildlife habitat.

Table 620-62 Sedge-Grass Tundra for Use as Wildlife Habitat.

RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	<1	1-2	>2	DEEP TO WATER
2. DEPTH TO PERMAFROST (ICE) (IN)	<20	20-40	>40	DEEP TO PERMAFROST
3. SOIL TEMPERATURE REGIME	PERGELIC	CRYIC	ALL OTHER SOIL TEMPERATURE REGIMES	EXTREME SOIL TEMPERATURES

(s) Herbaceous tundra for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing herbaceous tundra vegetation that is adapted to cold and moist soil conditions that are drier than those common to the wetter sites of sedge-grass and tussock tundra. The soils suitable for this habitat are normally moist throughout the summer months and may be perennially frozen at a moderately deep or deeper depth. They are generally found on piedmont slopes, rolling hills and foothills and in some areas of dunes. Many areas receive additional moisture from runoff during the spring thaw.

(2) These perennial and annual forb species are somewhat tolerant of periodic wet soil conditions. They are predominantly mesophytic and include some hydrophytic plants. The regeneration of plant species is normally through natural progression. Therefore, the plant species are usually native to the area. At the present time, there is minimal or no human influence, such as by the introduction of exotic species. Management is designed to return degraded areas to their potential or to maintain or increase the present vegetative cover and protect the vegetation from the impact of wildfires. A reduction of herbaceous tundra cover by animal, human, or wildfire interference opens the soil to increased thermal heating. This condition can cause a general lowering of the permafrost and any associated perched water table and thus result in potentially drier soil, which influences the adaptability of the herbaceous species. Invasion of the herbaceous tundra community by woody species and mosses can also increase the vegetation cover that protects the soil from solar radiation. The result is a reverse effect of cooling the soil and raising the depth to permafrost. These situations can initiate a successional change in the vegetation community from the more desirable herbaceous tundra species to species adapted to warmer and dryer conditions or to cooler and possibly wetter conditions. The guide, as shown in Table 620-63, is intended to provide minimal guidelines for the identification and selection of sites and potential sites for growing herbaceous tundra as wildlife habitat.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing herbaceous tundra vegetation. This information allows the user to identify the herbaceous tundra species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted herbaceous tundra vegetation as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted herbaceous tundra species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the herbaceous tundra vegetation as wildlife habitat.

(5) A number of rating criteria are not addressed in this guide because of the lack of available information about the effect of other soil properties on herbaceous tundra communities. As new information is available, rating criteria will be added to future updates of this guide.

(6) In most cases plant species may be regenerated and maintained naturally with little or no impact to the soil or existing vegetation by mechanical or other means. The management and reestablishment of herbaceous species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the herbaceous tundra species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of herbaceous tundra plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--A seasonal high water table can affect the establishment, growth, and survival of herbaceous tundra vegetation. A water table that is usually perched above the permafrost results in poorly aerated soils. Desirable herbaceous tundra vegetation is suited to moist, drained soil conditions. Growing forb species that are tolerant of soil wetness allows full utilization of the site.

2--Permafrost restricts the depth of forb root penetration and thus causes adverse affects on stand performance. Growing forb species that have root systems that are adapted to shallower soil depths allows full utilization of the site.

3--Soil temperatures that are too warm allow for unrestricted herbaceous tundra vegetative growth. Native species are usually the best alternative species to select for wildlife habitat.

Table 620-63 Herbaceous Tundra for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>3	1.5-3	<1.5	WETNESS
2.	DEPTH TO PERMAFROST (ICE) (IN)	>40	20-40	<20	ROOTING DEPTH
3.	SOIL TEMPERATURE REGIME	PERGELIC	CRYIC	ALL OTHER SOIL TEMPERATURE REGIMES	EXTREME SOIL TEMPERATURES

(t) Tussock tundra for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing tussock tundra vegetation that is adapted to cold and seasonally wet soil conditions. The soils suitable for this habitat are normally perennially frozen at shallow depths and are seasonally wet during the early to middle summer months. They generally occur on piedmont slopes, footslopes, hills, foothills, ridges, and mountains. Many areas receive excessive moisture as a result of runoff from the surrounding area after the spring thaw.

(2) These perennial grasslike species and mosses are water tolerant. They are predominantly hydrophytic and include some mesophytic plants. The regeneration of plant species is normally through natural progression. Therefore, the plant species are usually native to the area. At the present time, there is minimal or no human influence such as by the introduction of exotic species. Management is designed to return degraded areas to their potential or to maintain or increase the present vegetative cover and protect the vegetation from the impact of wildfires. A reduction of tussock tundra cover by animal, human, or wildfire interference opens the soil to increased thermal heating. This condition can result in a general lowering of the permafrost and perched water table and thus cause potentially drier soil. The result is that the effect of the perched water table on adapted plant species is reduced. Such a situation can initiate a successional change in the vegetation community from the more desirable, water-tolerant tussock tundra species to a drier, woody shrub-moss dominated vegetation community. The guide, as shown in Table 620-64, is intended to provide minimal guidelines for the identification and selection of potential sites for growing tussock tundra as wildlife habitat.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing tussock tundra vegetation. This information allows the user to identify the tussock tundra species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted tussock tundra vegetation as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted tussock tundra species for wildlife habitat and that some restrictive features limit their full potential for plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the tussock tundra vegetation as wildlife habitat.

(5) A number of rating criteria are not addressed in this guide because of the lack of available information about the effect of other soil properties on tussock tundra communities. As new information is available, rating criteria will be added to future updates of this guide.

(6) In most cases the plant species may be regenerated and maintained naturally with little or no impact to the soil or existing vegetation by mechanical or other means. The management and reestablishment of tussock tundra species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the tussock tundra species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of tussock tundra plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--Soils that are deep to a water table adversely affect the establishment and growth of tussock tundra vegetation. Desirable grasslike species and moss vegetation is adapted to wet soil conditions, especially if it is shallow rooted species. The management or selection of species that have deep root systems or that are adapted to drier soil conditions is more desirable for establishing habitat for wildlife.

2--Soils that are deep to permafrost adversely affect the establishment and maintenance of tussock tundra vegetation. The plants are shallow rooted and are dependent upon the permafrost to perch and maintain a water table at or near the soil surface during the growing season. Lower or deeper permafrost layers cause associated water tables to decrease in depth. The result is periodic drying and warming of the soil. Thus other species are allowed to invade the site and ultimately replace the desired tussock tundra species. Management should include maintaining or raising the permafrost and any associated water table to desirable levels.

3--Soil temperatures that are too warm restrict tundra vegetative growth. Native species are usually the best alternative species to select for wildlife habitat.

Table 620-64 Tussock Tundra for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	<1	1-1.5	>1.5	DEEP TO WATER
2.	DEPTH TO PERMAFROST (ICE) (IN)	<10	10-20	>20	DEEP TO PERMAFROST
3.	SOIL TEMPERATURE REGIME	PERGELIC	CRYIC	ALL OTHER SOIL TEMPERATURE REGIMES	EXTREME SOIL TEMPERATURES

(u) Upland shrub tundra for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing mainly medium and tall stature upland shrub tundra vegetation that is adapted to cold and moist soil conditions that are drier than those common on the wetter sedge-grass and tussock tundra sites. The soils suitable for this habitat are normally moist throughout the summer months and may be perennially frozen where they are deep or very deep. They generally occur along streams, drainageways, and footslopes on piedmont slopes, hills, foothills, ridges, and mountains. Many areas receive additional moisture from runoff during the spring thaw.

(2) These upland shrub tundra species have an understory of forbs, grasses, grasslike plants, and mosses. They are somewhat tolerant of periodic wet soil conditions. They are predominantly mesophytic and include some hydrophytic plants. The regeneration of plant species is normally through natural progression. Therefore, the plant species are usually native to the area. At the present time, there is minimal or no human influence, such as by the introduction of exotic species. Management is designed to return degraded areas to their potential or to maintain or increase the present vegetative cover and protect the vegetation from the impact of wildfires. A reduction of upland shrub tundra cover by animal, human, or wildlife interference opens the soil to increased thermal heating. This condition can cause a general lowering of the permafrost and any associated perched water table and thus result in potentially drier soil, which influences the adaptability of the shrub species. Loss of the medium and tall stature shrub component allows for the invasion of the short stature shrubs, grasses, grasslike plants, and mosses. This invasion increases the direct ground cover and protects the soil from solar radiation. The result is a reverse effect of cooling the soil and raising the depth to permafrost. These situations can initiate a successional change in the vegetation community from the more desirable upland shrub tundra species to species adapted to warmer and drier conditions or to cooler and possibly wetter conditions. The guide, as shown in Table 620-65, is intended to provide minimal guidelines for the identification and selection of potential sites for growing upland shrub tundra.

(3) The interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the site for growing upland shrub tundra vegetation. This information allows the user to identify the upland shrub tundra species that best meet the wildlife habitat requirements. Selection is made from a list of locally adapted species. Included in the list are native and introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted upland shrub tundra vegetation as wildlife habitat. A SUITED rating implies that the site is suited for the establishment or growth of climatically adapted upland shrub tundra species for habitat and that some restrictive features limit their full potential of plant growth. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the upland shrub tundra vegetation as wildlife habitat.

(5) A number of rating criteria are not addressed in this guide because of the lack of available information about the effect of other soil properties on upland shrub tundra communities. As new information is available, rating criteria will be added to future updates of this guide.

(6) In most cases plant species may be regenerated and maintained naturally with little or no impact to the soil or existing vegetation by mechanical or other means. The management and reestablishment of upland shrub tundra species to meet select wildlife habitat requirements is determined by a number of factors. The factors are landscape, climate, soil, vegetation, hydrology, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of the upland shrub tundra species. The guide addresses only those factors that relate primarily to the soil. It identifies the limitation and the soil restricting features that will have the most affect on the use of upland shrub tundra plants as wildlife habitat.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1--A seasonal high water table adversely affects the establishment, growth, and survival of upland shrub tundra vegetation. A water table that is usually perched above the permafrost results in poorly aerated soils. Desirable upland shrub tundra vegetation is suited to moist, drained soil conditions. Growing upland shrub species that are tolerant of soil wetness allows full utilization of the site.

2--Permafrost can restrict the depth of shrub root penetration, the growth potential of the woody plants, and stand performance. Growing shrub species that have shallow root systems allows full utilization of the site.

3--Soil temperatures that are too warm restrict upland shrub tundra vegetative growth. Native species are usually the best alternative species to select for wildlife habitat.

Table 620-65 Upland Shrub Tundra for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>5	3-5	<3	WETNESS
2.	DEPTH TO PERMAFROST (ICE) (IN)	>60	40-60	<40	ROOTING DEPTH
3.	SOIL TEMPERATURE REGIME	PERGELIC	CRYIC	ALL OTHER SOIL TEMPERATURE REGIMES	EXTREME SOIL TEMPERATURES

(v) Soil used as burrow wildlife habitat component for burrowing mammals and reptiles.

(1) The soil is interpreted as a habitat component according to its potential to be used by mammals and specific species of reptiles that excavate burrows. Burrows are considered a necessary part of specific local habitat requirements for certain targeted and nontargeted species of wildlife. The guide, as shown in Table 620-66, is intended to provide guidelines in the identification and selection of sites that have the most potential for preserving, maintaining, or increasing local populations of these species. Site identification of problem areas for control of pests, such as moles, ground squirrels, etc., is also another potential application of this guide.

(2) This interpretation guide is of a more general nature. It is designed to be used in the planning process to identify areas of concern prior to the application of conservation practices. Based upon the wildlife objectives, these areas can be avoided, practices can be adjusted to minimize damage to the burrow habitat, practices can be changed to overcome limitations by the presence of the burrows, or control measures can be used to eradicate pest species. The guide does not take into account climate or soil temperature that may influence the presence or distribution patterns of a species. The presence or absence of a species is determined at the local level.

(3) The interpretations provide suitability ratings and identify the dominant soil characteristics that influence the suitability of the site for burrowing mammals and reptiles. This information allows the user to plan and develop alternatives in site selection by identifying the site that best meets the wildlife habitat requirements. The user is required to develop a list of locally adapted wildlife species that excavate their own burrows and that utilize abandoned burrows to meet at least part of their habitat requirements. This list may include many other mammals, reptiles, and/or bird species.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for use by locally adapted animal species as wildlife habitat. Colonization and population densities may be above average if other habitat factors are not limiting. A SUITED rating implies that the site is suitable as habitat to locally adapted animal species and that some restrictive features may limit the use of the site by burrowing species. Colonization and population densities may be average for the area if the other habitat requirements are met. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, maintenance, or use of the site by burrowing species. Colonization and population densities may be restricted in the area due to the limiting factors even though all of the other species habitat requirements are met.

(5) The final identification and selection of a site suitable for burrowing mammals, reptiles, and other species capable of utilizing abandoned

burrows is determined by the limitation of the soil as it influences excavation, maintenance, and preservation of the burrows. The guide identifies the soil restricting features that will have the most effect on habitat.

(6) The assumptions made about the rating criteria listed in the table are as follows:

1--Permafrost restricts the ability of the animal to excavate burrows and also affects the thermal comfort of the burrow.

2--Flooding from stream overflow, runoff, or high tides adversely affects burrowing wildlife. In areas subject to flooding, the burrowing mammals and reptiles are evicted, species are drowned, and the walls of the burrows may collapse or become filled with debris. Any effort of the animals to return to the site is delayed until the floodwater has receded and the soils have dried sufficiently to allow renewed activity.

3--Ponding or standing water adversely affects burrowing species.

4--A seasonal high water table can affect burrowing species, restrict burrowing, and possibly cause drowning when the water table returns. Caving or tunnel collapse may be a problem, especially in those parts of the soil affected by the capillary fringe.

5--Sandy layers are soft and loose. Burrow excavation and maintenance are problems due to reduced sidewall stability and the tendency for collapse.

5a--Clayey layers are slippery and sticky when wet, are slow to dry, and, when dry, are usually hard. They affect the ability of the burrowing species to excavate. Species that have habitat requirements for sites deeper than very shallow or shallow are most affected.

5b--A high content of organic matter affects maintenance of the burrows due to reduced sidewall stability and the tendency to collapse. Highly fiberous organic materials are difficult to burrow.

6, 6a, & 6b--High concentrations of rock fragments adversely affect the excavation of soil by burrowing species. The physical effort to dislodge or transport the rock fragments from the burrow may be beyond the abilities of many species.

7, 8, & 9--Bedrock, a cemented pan, or dense layers adversely affect the potential depth of excavation by burrowing species. The layers are either too hard or too dense for the species to excavate.

Table 620-66 Soil Used as Burrow Wildlife Habitat Component for Burrowing Mammals and Reptiles.

RATING CRITERIA OR PROPERTY	LIMITS WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. USDA TEXTURE	----	----	ICE	PERMAFROST
2. FLOODING	NONE	RARE	OCCAS, FREQ	FLOODING
3. PONDING	----	----	ANY ENTRY	PONDING
4. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>20	10-20	<10	DEPTH TO ROCK
5. DEPTH TO CEMENTED PAN (IN)	>20	10-20	<10	CEMENTED PAN
6. DEPTH TO HIGH WATER TABLE (FT) (PERCHED AND APPARENT)	>3	1.5-3	<1.5	WETNESS
7a. USDA TEXTURE (THICKEST LAYER, 0-30")	VFSL, L, SIL, SI, SL, FSL	COSL, LS, LFS, LVFS	COS, S, FS, VFS, LCOS	TOO SANDY
7b. USDA TEXTURE (THICKEST LAYER, 0-40")	----	SICL, CL, SCL	SIC, C, SC	TOO CLAYEY
7c. USDA TEXTURE (0-20")	----	HM, MUCK, SP, MPT	FB, PEAT	EXCESS HUMUS
8a. PERCENT BY WEIGHT >3 (THICKEST LAYER, 0-30")	<10	10-25	>25	ROCK FRAGMENTS
8b. PERCENT BY WEIGHT 2MM-3" (0-30")	<50	50-75	>75	TOO GRAVELLY
9. DEPTH TO BULK DENSITY >1.8 (G/CC) (IN)	>20	10-20	<10	DENSE LAYER

(w) Soil used for crawfish aquaculture.

(1) The soil is interpreted for its potential to be used for shallow water impoundments necessary for aquaculture. Crawfish culture areas have dikes that are at least 3 feet high and that are capable of maintaining water levels at 1.5 to 2.0 feet for optimum crawfish production. The guide, as shown in Table 620-67, is intended to provide guidelines in the identification and selection of sites that have the best potential for implementation of aquaculture. It is not intended to reflect potential crawfish production levels that are usually more directly related to other management techniques.

(2) The interpretation guide is designed to be used in the planning process to identify areas of concern prior to the application of practices.

Based on the objectives for the crawfish culture, problem areas can be avoided and practices adjusted to overcome limitations and maintain good water quality and management. The guide does not take into account the quality of the water source used in aquaculture. Water that has concentrations of soluble salts over .6 PPM, exchangeable sodium, or more than 3 PPM of soluble iron can affect the survivability of both the crawfish and the vegetation growth used as crawfish forage. An additional concern is the potential for soil contamination at the site.

(3) The interpretations provide suitability ratings and identify the dominant soil characteristics that influence the suitability of the site for crawfish aquaculture. This information allows the user to plan and develop alternatives in site selection. Soils that are rated WELL SUITED have no restrictions to use and are favorable for crawfish aquaculture. A SUITED rating implies that the site is suitable for crawfish aquaculture and that some restricting soil features may limit site maintenance, water management, crawfish populations, and/or vegetative growth for crawfish forage. A POORLY SUITED rating indicates that the soil characteristics are such that they may severely limit the establishment and maintenance of crawfish and vegetation. Use of the site may also require restrictive conservation practices to overcome water management or site maintenance limitations. This rating can affect the value of the site for crawfish aquaculture.

(4) The final identification and selection of a site suitable for crawfish aquaculture is determined by the limitation of the soil. The limitations are the soil features that influence material available for dike construction, site maintenance, water management, or the soil chemical properties that affect crawfish and their vegetative forage. The guide identifies the soil restricting features that will have the most direct impact on crawfish aquaculture.

(5) The assumptions made about the rating criteria listed in the table are as follows:

1--Soil temperatures that are too cold restrict the establishment and growth of crawfish populations and the required crawfish vegetation forage.

2--Soils that are dry most of the time limit the availability of a reliable surface water source for use in the impoundments. Supplemental ground water may be needed to sustain crawfish aquaculture.

3--Soils that have sandy layers, excess humus, or gravelly material are unsuitable for the construction of dikes to impound water at the required levels for crawfish aquaculture due to material instability, piping, and the potential for structure collapse and ultimate failure.

4 & 12--Excess movement of water through the soil results in water loss from the pond area and thus causes difficulty in maintaining the proper water levels.

5--Slopes that are too steep require special practices to minimize problems with water management, structure, and soil erosion. The maintenance of adequate crawfish aquaculture structures becomes more difficult as the slope increases. If slope is extreme, it is better to select an alternative site.

6--Excess water-soluble salts restrict the growth of vegetation favored by crawfish as forage. Concentrations of soluble salts also contaminate the ponded water and adversely affect crawfish populations.

7--High concentrations of exchangeable sodium cause poor soil conditions that restrict the growth of most plants. They affect the establishment and growth of vegetation favored by crawfish for forage.

8--Soils that are too acid restrict plant growth and thus reduce the amount of preferred vegetation. Acid soils generally contain sulfuric acid, have low base saturation, and have the potential for aluminum and/or manganese toxicity. Soil amendments are a management consideration.

9--The absence of a seasonal high water table can affect crawfish aquaculture. A seasonal high water table can provide a water source as well as reduce the need for additional outside water. Shallow water tables help to reduce subsoil water losses and maintain pond depth.

10 & 11--Soils that have bedrock or cemented pans restrict the use of the site for crawfish aquaculture because they lack sufficient overlying material for both dike construction and aquacultural practices. Ponding over bedrock and cemented pans results in lateral seepage and wetness problems outside the site area.

13--Floodwater that overtops the dikes causes changes in the controlled aquaculture water levels, deposits sediment, and contaminates water. Dikes can breach or erode. Loss of crawfish and their vegetative forage may result.

Table 620-67 Soil Used for Crawfish Aquaculture.

RATING CRITERIA OR PROPERTY	LIMITS WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. SOIL TEMPERATURE REGIME	THERMIC, HYPER-THERMIC	MESIC	FRIGID, CRYIC, PERGELIC	EXTREME SOIL TEMPERATURES
2. MOISTURE REGIME	UDIC	USTIC	ARIDIC	TOO ARID
3. UNIFIED (0-40 IN)	---	---	SP, SW OH, PT GW, GP, GM, GC	TOO SANDY EXCESS HUMUS TOO GRAVELLY
4. PERMEABILITY (IN/HR) (20-60 IN, SLOWEST LAYER)	<0.06	0.06-0.2	>0.2	SEEPAGE
5. SLOPE (PCT)	<1	1-3	>3	SLOPE
6. SALINITY (MMHOS/CM) (0-40 IN)	<4	4-8	>8	EXCESS SALT
7. SAR (0-40 IN)	---	---	>13	EXCESS SODIUM
8. SOIL REACTION (pH) (SURFACE LAYER)	>5.5	5.5-4.5	<4.5	TOO ACID
9. DEPTH TO HIGH WATER TABLE (FT) (PERCHED OR APPARENT)	<2	2-3	>3	DEEP TO WATER
10. DEPTH TO CEMENTED PAN (IN)	>60	40-60	<40	CEMENTED PAN
11. DEPTH TO BEDROCK (HARD OR SOFT, IN)	>60	40-60	<40	DEPTH TO BEDROCK
12. USDA TEXTURE (ALL DEPTHS)	ALL OTHER TEXTURES	---	GRAVELS, SANDS, MARL, GYPSUM	SEEPAGE
13. FLOODING (DEPTH, FT)	---	---	>3	FLOODING

(x) Upland mixed deciduous-conifer trees for use as wildlife habitat.

(1) The soil is interpreted as a medium for growing mixed deciduous-conifer trees that meet specific local habitat requirements for targeted and nontargeted species of wildlife. Commonly, deciduous trees are established through natural processes, are seeded, or are transplanted. In general, better soil conditions are required for mixed stands to maintain the deciduous tree component; however, many of the conifer species adapt to harsher soil conditions.

(2) The intent of the guide, shown in Table 620-68, is to provide minimum soil restriction guidelines for the selection of mixed deciduous-conifer tree species for growing wildlife tree habitat and not to reflect commercial tree growth for timber harvest. In reality, it is not uncommon for the two land use objectives to be met at the same time.

(3) This interpretation guide is of a more general nature. It provides suitability ratings and identifies the dominant soil characteristics that influence the suitability of the soil to grow mixed deciduous-conifer trees. This information allows the user to plan and develop alternatives in site selection and identify the adapted tree species that best meet the wildlife habitat requirements. The user is required to develop a list of locally adapted tree species. Included in the list are native or introduced species, their suitability ratings, and their ability to adapt to each restrictive feature.

(4) Soils that are rated WELL SUITED have no restrictions to use and are favorable for all locally adapted mixed deciduous-conifer trees as wildlife habitat. A SUITED rating implies that the site is suitable as habitat and that some restrictive features limit its full potential. A POORLY SUITED rating indicates that the soil characteristics are such that they may limit establishment, growth, maintenance, or performance and thus affect the value of the mixed deciduous-conifer trees as wildlife habitat.

(5) Rating criteria not addressed in this guide are aspect, carbonates, cation exchange capacity, reaction (PH), salinity, and sodicity. These properties are too variable between adapted mixed deciduous-conifer tree species and are better addressed independently at the local level when making the final selection of species. The frequency and duration of flooding or ponding are also not considered as rating criteria. Tree species that have specific water requirements can easily be handled in one of the other guides.

(6) The introduction or reestablishment of mixed deciduous-conifer trees to meet select wildlife habitat requirements is determined by a number of factors. These factors are landscape, climate, soil, vegetation, and time. A limitation caused by any one of these factors can influence the adaptability, survival, growth, and vigor of a tree stand. The guide addresses only those factors that relate primarily to the soil.

(7) The assumptions made about the rating criteria listed in the table are as follows:

1a & 1b--A low available water capacity means that the ability of the soil to provide continual moisture to mixed deciduous-conifer trees is lower than is desirable. This condition makes it more difficult for trees to establish or survive naturally. Drought-resistant deciduous and conifer tree species that have low moisture requirements should be selected or supplemental irrigation should be planned for stand establishment and maintenance.

2a & 2b--A water table that is high for extended periods during the growing season can affect tree growth and survival. The selection of deciduous and conifer tree species that are tolerant of soil wetness are desirable for establishing wildlife habitat.

3 & 4--Bedrock or cemented pans restrict the depth of tree root penetration and can thus cause windthrow and have other adverse affects on stand performance. The selection of deciduous and conifer tree species that have shallow root systems allows full utilization of the site.

5--Soils that are dry most of the time may not be able to recharge soil moisture and sustain deciduous and conifer trees during the normal growing season. Selecting drought-resistant deciduous and conifer tree species helps to overcome this limitation. Irrigation practices may be necessary for tree establishment and maintenance to obtain the desired wildlife habitat.

Table 620-68 Upland Mixed Deciduous-Conifer Trees for Use as Wildlife Habitat.

	RATING CRITERIA	WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1a.	AVAILABLE WATER CAPACITY (UDIC SOILS, AVERAGE TO 40") (IN/IN) (IN)	>0.10 >4.0	0.05-0.10 2.0-4.0	<0.05 <2.0	DROUGHTY
1b.	AVAILABLE WATER CAPACITY (ARIDIC, XERIC, USTIC SOILS, AVERAGE TO 40") (IN/IN) (IN)	>0.10 >6.0	0.05-0.10 3.0-6.0	<0.05 <3.0	DROUGHTY
2a.	DEPTH TO HIGH WATER TABLE (PERCHED OR APPARENT, FT)	>5	3-5	<3	WETNESS
2b.	WATER TABLE DURATION (GROWING SEASON, MONTHS)	<1	1-2	>2	WETNESS
3.	DEPTH TO BEDROCK (HARD OR SOFT, IN)	>40	20-40	<20	ROOTING DEPTH
4.	DEPTH TO CEMENTED PAN (IN)	>40	20-40	<20	ROOTING DEPTH
5.	SOIL MOISTURE REGIME	UDIC, XERIC, AQUIC	USTIC	ALL OTHER SUBGROUPS	TOO ARID

620.15 Agronomic Practices.

(a) Fencing.

(1) Fencing is the construction and maintenance of barriers for the management of animals. Fences are constructed using metal or wooden posts that are either treated or untreated to prevent rotting. The posts are buried at least 2 feet into the soil with strands of wire suspended between the posts.

(2) The guide, as shown in Table 620-48, is used to rate the ease of setting posts, maintaining the wire tension, and estimating the replacement and maintenance cost. Excavations for wooden posts are made by power auger or hand dug, metal posts are driven into the soil.

(3) Bedrock, cemented pan, and large and small stones influence the excavation of post holes and the driving of posts. Flooding and depth to a seasonal high water table may restrict the season of construction. Flooding also affects maintenance and replacement cost. High water tables raise the maintenance cost and require deeper post settings. High shrink-swell soils require deep post settings or rock jacks to maintain vertical post alignment. Setting posts in permanently frozen soil may cause lose of the insulation qualities of the soil and result in thermokarst topography. Post alignment and maintaining the desired wire tension are often difficult on sandy soils due to their low strength. Soil blowing causes maintenance problems. Frost action results in frost-heaving of the posts. Steep slopes affect the use power augers and the delivery of supplies. During the wet seasons surface creep on steep slopes increases maintenance. Soil reaction and salinity affect the type of post selected and maintenance costs.

(4) Soil map units that contain more than 10 percent rock outcrops should be rated SEVERE.

Table 620-69 Fencing.

RATING CRITERIA OR PROPERTY	LIMITS			RESTRICTIVE FEATURE
	WELL SUITED	SUITED	POORLY SUITED	
1. USDA TEXTURE	---	---	ICE	PERMAFROST
1a. TEXTURE (WEIGHT AVE. 0-24")	---	---	SC, SIC, C	TOO CLAYEY
1b. TEXTURE (WEIGHT AV. 0-24", KAOLINITIC MINERALOGY AND OXIC SUBGROUPS, AND OXISOLS AND UDIC MOISTURE REGIME)	---	SC, SIC, C	---	TOO CLAYEY
1c. TEXTURE (WEIGHT AV. 0-24")	---	LS, LCOS, VFS, LFS, LVFS	COS, S, FS	TOO SANDY
2. FLOODING	NONE, RARE	OCCAS	FREQ	FLOODING
3. DEPTH TO BEDROCK (HARD OR SOFT, IN)	---	---	<24	DEPTH TO ROCK
4. DEPTH TO CEMENTED PAN THICK (IN)	---	---	<24	CEMENTED PAN
4a. DEPTH TO CEMENTED PAN THIN (IN)	>20	10-20	<10	CEMENTED PAN
5. WEIGHT PERCENT 2 mm-<3" (0-24")	<25	25-50	>50	TOO GRAVELLY
5a. WEIGHT PERCENT 3-10" (0-24")	<25	25-50	>50	TOO COBBLY
5b. WEIGHT PERCENT >10" (0-24")	<5	5-15	>15	TOO STONY
6. SHRINK-SWELL THICKEST LAYER 0-24", >12" THICK, LE (PCT)	---	---	>6	SHRINK-SWELL

Table 620-69 Fencing (continued).

RATING CRITERIA OR PROPERTY	LIMITS WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
6a. SHRINK-SWELL THICKEST LAYER 0-24", <12" THICK, LE (PCT)	---	>6	---	SHRINK-SWELL
7. PONDING	---	---	+	PONDING
8. DEPTH TO HIGH WATER TABLE (FT)	>2.0	---	<2.0	WETNESS
9. SLOPE (PCT)	<8	8-15	>15	SLOPE
10. POTENTIAL FROST ACTION	---	HIGH	---	FROST ACTION
11. SALINITY (MMHOS/CM)	---	>8	---	EXCESS SALT
12. SOIL REACTION (pH)	---	<3.5	---	TOO ACID

(b) Tillage.

(1) Tillage is the use of mechanized equipment to disturb and to mix the soil usually to a depth of 3 to 12 inches from the surface. Tillage occurs throughout the year while preparing for planting, controling weeds, and harvesting forage and field crops.

(2) The guide, as shown in Table 620-40, is used during the planning process to evaluate the timing, the ease, and the effectiveness of cultivation with tractor-pulled implements including the plow, disc, cultivator, and harrow.

(3) Rock fragments potentially damage equipment. Ponding, flooding, and high water table affect the timing of tillage by limiting access to fields. High clay content reduces effectiveness of of the tillage implements.

(4) Excess sodium or excess salt in the rooting zone limit crop growth after tillage.

Table 620-70 Tillage.

RATING CRITERIA OR PROPERTY	LIMITS WELL SUITED	SUITED	POORLY SUITED	RESTRICTIVE FEATURE
1. USDA TEXTURE	---	CL, SICL	SIC, C	TOO CLAYEY
2. WEIGHT PERCENT 3-10"	<5	5-35	>35	TOO COBBLY
2a. WEIGHT PERCENT >10"	<5	5-15	>15	TOO STONY
3. ORGANIC MATTER CONTENT (%)	>4	2-4	<2	CRUSTING
4. DEPTH TO HIGH WATER TABLE (FT)	>2	1-2	0-1	WETNESS
4a. PONDING	---	---	+	PONDING
5. FLOODING	NONE, RARE	OCCAS	FREQ,	FLOODING
6. SODIUM ADSORPTION RATIO (GREAT GROUP)			>12 (NATRIC)	EXCESS SODIUM
7. SALINITY (MMHOS/CM)	<4	4-8	>8	EXCESS SALT
8. PERMEABILITY (IN/HR) (0-24")	>0.2	0.06-0.2	<0.06	PERCS SLOWLY
9. WIND ERODIBILITY GROUP	---	3, 4L, 4	1, 2	SOIL BLOWING

Part 621 - SOIL POTENTIAL RATINGS

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Part 621 - SOIL POTENTIAL RATINGS

621.00 Definition and Purpose.

(a) Soil potential ratings are classes that indicate the relative quality of a soil for a particular use as compared with those of other soils in a given area. The following are considered in soil potential ratings:

- -- yield or performance level,
- -- the relative cost of applying modern technology to minimize the effects of any soil restrictions, and
- -- the adverse effects of continuing limitations, if any, on social, economic, or environmental values.

The criteria for developing soil potential ratings for a particular use are established specifically for a given area. The criteria may be different in nearby areas, counties, groups of counties, groups of states, or regions.

(b) The purpose of soil potential ratings is to identify within an area the relative suitability of soils for a given use while considering economic, social, and environmental values.

621.01 Policy and Responsibilities.

(a) The Natural Resources Conservation Service (NRCS) is responsible for providing assistance to units of government and others in preparing and using soil potential ratings. The NRCS state staffs acquaint local, State, and other units of government with soil potential ratings and how they can be used, takes leadership in initiating the preparation of potential ratings, and encourages their use. Soil conservationists, soil scientists, engineers, and others provide guidance in interpreting soil survey data and in establishing procedures for preparing potential ratings. The NRCS state staffs encourage technical experts from other agencies and institutions to participate in the preparation of potential ratings.

(b) The National Soil Survey Center is responsible for:

-- developing and implementing the policies and procedures used to develop and apply soil potential ratings.

621.02 General.

(a) Soil potential ratings are developed primarily for planning purposes and are not recommendations for soil use. They help decision makers to determine the relative suitability of soils for a given use. They are used with other resource information as a guide to making land use decisions.

(b) Soil potential ratings supplement other groupings and interpretations given in soil handbooks and technical guides.

(c) The procedures for rating soil potentials have been prepared as guides. The procedures should allow a maximum of flexibility.

(d) Soil potential ratings have been adopted as a form of soil interpretations to:

- -- provide a common set of terms, which are applicable to all kinds of land use, for rating the quality of a soil for a particular use relative to that of other soils in the area;
- -- identify the corrective measures needed to overcome limitations and the degree to which the measures are feasible and effective;
- -- allow for the preparation of soil interpretations and the use of local criteria to meet local needs;
- -- provide information about soils that emphasizes the feasibility of a use rather than avoidance of problems;
- -- combine information on soils, corrective measures, and the relative costs of corrective measures;
- -- make soil surveys and related information more applicable and easy to use in resource planning; and
- -- strengthen the resource planning effort by more effectively communicating the information provided by soil surveys and properly relating that information to modern technologies.

621.03 Developing Soil Potential Ratings.

(a) The development of soil potential ratings requires procedures that identify (1) soil performance levels, (2) measures for overcoming soil limitations, and (3) the limitations that remain after corrective measures have been applied. These procedures must also allow for a numerical system from which a soil potential index and soil potential ratings can be derived. The information is assembled and presented to users in the form of soil map unit descriptions and tables or maps.

(b) The number of soil uses for which potential ratings are prepared varies from area to area. The importance of the soil use and the number of people who would use information on it must be considered. If soil potential ratings are prepared for a specific soil use, all soils in the geographic area of interest should be rated for that same use.

(c) Soil potential ratings are prepared for any geographic or political area.

(d) Soil potential ratings are prepared regardless of map scale or kind of map unit. Components of multitaxa map units can be evaluated separately to supplement the overall evaluation of a map unit. The soil uses for which soil potential ratings are prepared should be consistent with the detail of mapping.

(e) Required, optional, and suggested aspects of NRCS policy and procedures for preparing soil potential ratings are provided in Exhibit 621-1.

(f) The evaluations of soil potential ratings must be made with the assistance of specialists in fields that are most closely related to the specific use.

NRCS personnel provide leadership in the procedures and assist in identifying the soil properties, the soil qualities, and the composition of map units. Technical experts from outside NRCS must concur in decisions concerning performance standards, the means and feasibility of overcoming soil limitations, and the indices for the costs of corrective measures and the continuing limitations. They must concur in decisions on the criteria, the numerical values derived, and the break points between rating classes.

621.04 Steps in Preparing Soil Potential Ratings.

The following steps are suggested as a logical sequence for preparing and presenting soil potential ratings:

-- acquaint users with soil potential ratings, determine user needs, and initiate action;
-- identify which technical specialists will participate;
-- review procedures and evaluate the adequacy of documented supporting data;
-- collect additional data as needed;
-- prepare soil potential ratings;
-- review and approve ratings as needed;
-- prepare ratings in final format; and
-- distribute the ratings and train users.

621.05 Collecting Data.

(a) Soil characteristics and performance data must be available before soil potential ratings can be prepared for a particular use. Data needs must be appraised before the soil potential ratings are prepared. If data are insufficient, a plan must be prepared for obtaining the needed information. The data needed, the individuals responsible for their collection, and the target dates for completion must be identified. The data include but are not limited to:

-- soil properties and qualities,
-- limitations for the use that are caused by the soil properties and qualities and the composition of the soil map units,
-- the kinds of corrective measures needed to overcome the limitations,
-- the relative cost or difficulty of overcoming the limitations for the installation of a given practice,
-- the relative costs or difficulties of overcoming the limitations that continue after given practices are installed, and
-- the level of performance.

Many of the data needs are documented and are available in technical guides and practice specifications.

(b) Other data can be collected through observations that are made and recorded in the course of day-to-day activities or through the systematic efforts of NRCS personnel, cooperating agencies and institutions, local experts, or others.

621.06 Definition of Soil Potential Classes.

(a) Relative terms are assigned to classes to indicate the potential of a soil for a particular use as compared with that of other soils in the area. The same soils in a different area may have different ratings for a given use. The rating classes do not identify the most profitable soil use or imply a recommendation for a particular use. For example, a soil rated as having a high potential for both forest land and cropland may be much more profitable in one use than in the other.

(b) Five classes are provided for comparative ratings of soil potential: (1) very high, (2) high, (3) medium, (4) low, and (5) very low. Very high potential is assigned only to soils having properties that make them exceptionally well suited to the particular use. Very low potential is assigned only to soils having properties so unfavorable for the use that they are virtually unsuited. The number of classes used in the final ratings depends on the range of potentials in the area and the degree of refinement needed. Three classes are enough for many areas.

(c) In a few geographic areas, only two classes of soil potential are needed because all soils in the area are either well suited or poorly suited to the use. If a wide array of potential is not present, only two rating classes may be needed, such as high and medium or medium and low. It may be important to prepare soil potential ratings, however, to identify widely different kinds of treatments that are needed for different soils. Ratings of the potential of individual soils generally are not needed in areas where all soils have the same rating for a given use.

(d) The highest or lowest potential rating class in which a soil can be placed is determined by local standards which are established by users and specialists. For example, if corn is not well adapted in an area, the best rating class for that area may be no better than medium. However, wheat may be well adapted in the same area and may have very high as the best potential rating. As another example, the best soils for dwellings in a certain area may have medium potential because of high building costs. Thus, a rating of "high" would not be used because it might be misleading. Similarly, if all soils in an area are well suited to a use, a "low" potential rating may have an inaccurate connotation.

(e) The rating classes are defined in terms of the production or performance expected of a soil if feasible measures are taken to overcome its limitations and in terms of the cost of such measures and the magnitude of the limitations that remain after the measures have been applied. The production or performance of each soil is compared with standards that are established locally for each soil use. The following class terms and definitions are used nationwide:

--Very high potential. Production or performance is at or above local standards because soil conditions are exceptionally favorable, installation or management costs are low, and soil limitations are insufficient.

--High potential. Production or performance is at or above the level of locally established standards, the cost of measures for overcoming soil limitations are judged locally to be favorable in relation to the expected performance or yields, and soil limitations that continue after corrective measures are installed do not detract appreciably from environmental quality or economic returns.

--Medium potential. Production or performance is somewhat below locally established standards, the costs of measures for overcoming soil limitations are high, or soil limitations that continue after corrective measures are installed detract from environmental quality or economic returns.

--Low potential. Production or performance is significantly below local standards, measures that are required to overcome soil limitations are very costly, or soil limitations that continue after corrective measures are installed detract appreciably from environmental quality or economic returns.

--Very low potential. Production or performance is much below locally established standards, severe soil limitations exist for which economically feasible measures are unavailable, or soil limitations that continue after corrective measures are installed seriously detract from environmental quality or economic returns.

(f) The soil uses for which soil potentials ratings are prepared should be consistent with the detail of mapping. Soil potential ratings for broad categories of soil uses, such as cropland, forestland, rangeland, or residential land, are appropriate for all levels of soil surveys regardless of the kinds of components that make up the soil map units. Ratings for the more specific soil uses, such as for strawberries or avocados or for dwellings or septic tank absorption fields, are appropriate for detailed soil surveys that have consociation and complex map units. Soil potential ratings for the more specific soil uses are seldom appropriate for general soil map units. The rule of restricting specific soil potential ratings to detailed consociation and complex map units should be generally followed. Soil potential ratings for broad categories of soil use are more appropriate for generalized soil map units, which are broadly defined and are used for broad base planning.

621.07 Soil Potential Index Concept.

The soil potential index (SPI) is a numerical rating of the relative suitability or quality of a soil. It is used to rank soils from high to low, according to their potential. The SPI is derived from the indexes of soil performance, cost of corrective measures, and costs established for continuing limitations. The SPI is expressed by the equation:

$$SPI = P - (CM + CL)$$

where: P = Index of performance or yield as a locally established standard

CM = Index of costs of corrective measures to minimize the effects of soil limitations

CL = Index of costs resulting from continuing limitations

The index values used are of a general nature. A highly detailed economic analysis of costs and returns is not required. The values for CM and CL must be on the same basis. If CM is on an annual basis, CL must also be on an annual basis. If CM is based on the total initial cost of corrective measures and CL is known only on an annual basis, economic analysis is required to derive common values for comparison. After a common basis is established for the costs of CM and CL, the costs can be reduced to index values. The SPI can be based on a percentage of the cost or on any other index desired.

(a) The Performance or Yield Standard (P). P is a locally defined and determined standard that represents index of a performance or yield for the area. The actual yield or performance of each soil is compared to this local standard. For some soils, the yield or performance level exceeds the standard. In this case, the SPI is adjusted upward on worksheets to reflect the higher yield or performance for the soil. Substandard yield or performance is included as a continuing limitation cost (CL). These values, or their equivalents if some other relative index is used, are entered on worksheets for calculating SPI. How often the crop is grown, either annually or less often because of needed crop rotations, must be considered when defining P. The rotation crops with low returns can be included by increasing CL as needed. P need not be an absolute measure, such as estimated yield.

(1) In most situations, the local standard chosen for P is above the performance level of the average soil in the area but may be lower than that achieved on the very best soils. A standard for corn yields in Alpha County, Any State, may be set at 120 bushels per acre per year; the SPI is adjusted up or down to reflect the expected yield relationship for any given soil. For example, for Alpha silt loam with an estimated yield of 132 bushels per acre:

WHERE: the local standard yield is 120 bu/ac corn and the local standard SPI is equal to 100

THEN: Alpha silt loam with a corn yield of 132 bu/ac would have a SPI of 110

SPI Alpha silt loam = 132/120 X 100 (standard SPI)
SPI = 110

In these examples, an SPI value of 100 is used to represent a standard yield of 120 bushels per acre.

(2) For soils with yields less than the standard, the lower yield is considered a continuing limitation (CL), which is equal to a factor representing the amount the yield is below the standard. For example, for Beta silt loam with an estimated corn yield of 102 bushels per acre:

WHERE: the local standard yield is 120 bu/ac corn and the local standard SPI is equal to 100

THEN: Beta silt loam with a corn yield of 102 bu/ac would have a SPI of 85

SPI Beta silt loam = 102/120 X 100 (standard SPI)
SPI = 85

In these examples, an SPI value of 100 is used to represent a standard yield of 120 bushels per acre.

(b) Cost of Corrective Measures (CM).

(1) CM is an index of added costs, which are above those for a defined standard installation or management system that is commonly used, given that there are no soil limitations that must be overcome. At the standard level, the value of CM is zero and thus no deductions would be made in deriving SPI. In unusual situations where a soil is so uniquely suited that costs incurred to obtain the desired level of performance are less than the standard, CM may be a negative value and thus increase the SPI.

(2) Examples of costs of corrective measures for agricultural uses are those for terraces or drainage systems. Costs for such measures can be converted to an annual basis for index values that are compatible with values for P and CL. Whether or not the corrective measures have already been installed is normally not considered, unless it is determined locally that costs already incurred for major irrigation, drainage, or flood control projects should be disregarded.

(3) Added expenses for measures such as increasing the size of a septic tank absorption field, strengthening a foundation, or construction grading for site preparation are examples of corrective measure costs for nonagricultural uses. In many cases, these kinds of costs may be handled as total initial costs rather than as prorated annual costs.

(4) Wherever possible, corrective measures that can at least partially overcome soil limitations should be identified. Management techniques, as well as agronomic or engineering practices, are considered corrective measures. If wetness affects forestland harvest and drainage is not feasible, one should present scheduling of logging operations for dry seasons as a corrective measure rather than list a wetness problem with no solution as a continuing limitation. An important aspect of the procedure for preparing soil potential ratings is that NRCS or cooperating agencies assist in identifying technologies that are or, according to local experts, should be considered workable options locally. NRCS or cooperating agencies or institutions should assist the local experts in properly relating those technologies or measures to kinds of soil.

(c) Cost of Continuing Limitations (CL).

(1) Limitations that continue after corrective measures have been applied have adverse effects on social, economic, or environmental values. Distinctions between the three kinds of values need not be made. Continuing limitations that affect returns or profits are clearly economic. Those that result in the pollution of air or water are social and environmental effects. CL is an index of costs that result from such soil limitations.

(2) Continuing soil limitations are grouped as three types: (i) performance limitations, such as low yields, human inconvenience or discomfort, periodic failure, limitations resulting from the size, shape, or accessibility of an area, or associated soils that restrict the use of a soil or its period of use; (ii) annual or periodic maintenance costs, such as pumps that remove excess water, irrigation, maintenance of drainage or terrace systems, or pumping and removal of septic tank waste; and (iii) offsite damage from sediment or other forms of pollution.

(3) The following examples illustrate the derivation of CL:

(i) If the local performance standard is 2,000 pounds per acre, a potential production of only 1,500 pounds per acre from rangeland in a normal year, as obtained through the use of all feasible corrective measures to increase yields, is substandard by 500 pounds. Where P is 100, an appropriate index value for CL is:

$$25 = \frac{(2{,}000 - 1{,}500 \times 100)}{2{,}000}$$

(ii) If the flooding of a dwelling remains a probability after feasible measures are installed, an estimate of the damage and inconvenience resulting from a flood event divided by the frequency of flooding can provide an annual cost for conversion to index values. For example, damages of $6,000 might be estimated to result from floods that occur 1 year in 10. The annual cost would be $600 and thus constitutes a serious continuing limitation. An appropriate value for CL might be 60 if the index for P is 100.

(iii) Other values for CL are estimated on the basis of costs to insure against damage, including flood insurance, costs of maintenance, costs for using substitute facilities during periods of malfunction, penalties that might result from offsite or environmental damages, or combinations of such costs. The assignment of a cost index to some continuing limitations is arbitrary out of necessity.

621.08 Procedures for Preparing Soil Potential Ratings.

An early step in the procedures for preparing soil potential ratings is the assembly and evaluation of soil-related data on yields, performance levels, local corrective measures, and limitations that continue after treatments are applied. Published soil surveys, soil handbooks, technical guides, research data, and information from sanitarians, contractors, builders, developers, and others are potential sources of data. The amount of useful data varies from area to area, depending on the extent of soil used for a particular purpose.

(a) If the soils have been used extensively for the purpose or crop being evaluated, the derivation of SPI is the most direct and most accurate. The needed corrective measures are well known. The actual performance or yield represents an integration of the effects of corrective measures and soil properties and is also well known. Thus, one does not need to infer or derive relationships among properties, measures, and yields to arrive at the indexes.

(b) If soils are being evaluated for purposes for which they are not now used or are used in only a few places, the corrective measures and the other indexes that are needed must be inferred. In these cases, two basic approaches are used to derive SPI.

(1) If soils similar to the soils being evaluated are used for the purpose being evaluated, the evaluations are based on the performance of the similar soils and the corrective measures needed to overcome their limitations. Adjustments can be made to slightly raise or lower the performance level or to modify the measures in order to account for properties of the soils being evaluated that are more or less favorable than those of the similar soils.

(2) If information on corrective measures and the actual performance of similar soils is not available, the soil properties that affect the particular use are identified and the soils are evaluated on the basis of proved relationships between properties and performance. If this approach must be used, careful consideration should be given to whether or not the ratings are needed or appropriate.

621.09 Defining Soil Use, Performance Standards, and Criteria for Evaluation.

(a) The soil use must be defined, evaluation criteria prepared, and a local performance standard established. Exhibits 621-2 and 621-3 are examples. The definition of the use prescribes the conditions to which the soil potential ratings apply. In effect, the definition states the assumptions to which the ratings apply and it must be carefully considered. Examples of definitions include:

- -- for cropland, the kinds of crops grown and the basic management systems used;
- -- for dwellings, the density or size of the lots;
- -- for septic tank absorption fields, whether or not a municipal water supply is assumed; and
- -- for numerous uses, the kind or size of equipment used or the methods or procedures followed in the installation of corrective measures.

(1) A performance standard is established and included as a part of the definition.

(2) Evaluation criteria are prepared that list the soil site and other factors that affect the intended use. Exhibits 621-2 and 621-3 are examples. External features, such as size and shape of an area, relationship of soils to other soils, regulations, and significant map unit inclusions or miscellaneous areas, such as rock outcrops, that are characteristic of map units, may be included as factors.

(3) The soil factors selected are those that affect yield or performance, require corrective measures, or cause limitations for the use. The factors that are considered in rating taxonomic units by degree of limitation are sufficient for some uses. For other uses, criteria for map units may be needed in addition to those for taxonomic units.

(4) For each soil factor, a range of conditions that is related to the kind and relative cost of corrective measures that are needed to overcome or minimize the effect of the limitation is established. Exhibit 621-4 is an example. Assigning degrees of limitations to each factor may be helpful. If so, the coordinated ratings from the soil database are used. For some uses or for some factors that are selected as evaluating criteria, coordinated soil limitation ratings are not available. In these cases, the limitation ratings can be assigned locally. However, the ratings of degree of limitation that have not been coordinated are not presented to users in text or tables even though they may have been used in preparing soil potential ratings. For some factors, the ranges in properties that are used for rating soil limitations may need to be subdivided. For example, in evaluations for dwellings, the range for slopes greater than 15 percent may need to be subdivided into ranges for slopes 15 to 30 percent, 30 to 50 percent, and 50 to 80 percent. Even though all these slope classes present severe limitations, differences may exist in the kinds and costs of corrective measures and continuing limitations and be significant for soil potential ratings.

(b) One approach to a systematic procedure for preparing soil potential ratings is illustrated in Exhibits 621-1, 621-5, and 621-6. Separate sheets are used for each map unit and for each soil use. The worksheets are prepared by states. Copies of completed worksheets are retained in NRCS offices as documentation of the procedures used.

(c) General guidance for completing worksheets is given in this section. Examples of completed worksheets are provided for forest land (Exhibit 621-7), for septic tank absorption fields (Exhibit 621-8), and for dwellings without basements (Exhibit 621-9). Steps for completing the worksheet are as follows:

(1) Enter the name of the map unit. Soil potential ratings are prepared for the map unit according to whether it is a multitaxa or a single taxon unit. Separate worksheets are suggested if two or more taxonomic units are named, but the final index for the unit depends on indexes of the components and the size, extent, and relationship of each component to another. Methods of properly integrating the ratings of two or more taxonomic units into one rating for the map unit are prepared locally and must be documented for each soil map unit.

(2) Enter for each use the factors that affect the use, as identified in the criteria for evaluation. Exhibits 621-2 and 621-3 provides an example.

(3) Enter for each soil the class or range of each soil property, class, or factor that is used as an evaluation factor, such as shrink-swell--high, textural class--loam or sandy loam, Unified soil classification--SM, and depth to bedrock--20 to 40 inches.

(4) If limitation ratings, which is optional, are assigned, they are entered on the worksheet. Such ratings may be of particular value to individuals outside NRCS who are assisting with the ratings. If limitations are not used, indicate in some way when a soil factor presents an adverse effect and requires further consideration in the evaluation.

(5) Factors rated as moderate or severe limitations, or those indicated by other means, impose one or more adverse effects on the performance or the installation of the facility. Such factors include erosion, surface seepage, equipment limitations, reduced yields, or foundation failure. Enter the nature of these effects on the use or installation if no precautions or corrective measures are applied. List only the major effects that require correction.

(6) For each soil limitation, list one or more kinds of corrective measures that can overcome or minimize its effect and enter the cost index. For example, measures that are needed to overcome the effect of a high water table on soybeans may include delaying planting until the water table recedes, installing drainage tile, or providing drainage through land grading. The same measure may overcome two or more limitations. Enter the cost index for that measure only once.

(i) For soils with slight limitations, it may be desirable to identify a measure or set of measures in order to provide users with a complete list of recommendations for all soils. "Conventional systems" for septic tank absorption fields and "conventional design" for foundations are examples of these measures. The standards for the conventions are provided in the definition of the soil use.

(ii) As a general rule, no corrective measures are given for soils that have a slight limitation because these soils generally represent the standard. For some uses, however, there are variations in conventional installations even though only slight limitations exist and it may be desirable to identify them. For example, because of variations in percolation rates, there is a significant difference in the size required for septic tank absorption fields among soils that have slight limitations. Entries on worksheets might show "conventional system, small field" or "conventional system, medium field" to make this distinction.

(iii) An index of the costs of corrective measures to overcome limitations is a major factor in assessing soil potential. Significant ranges of these costs can be established, and index numbers rather than actual dollar values can be assigned. Exhibit 621-3 provides an example. This procedure can provide adequate distinctions between the costs of corrective measures, make evaluation easier, and avoid becoming too precise. Cost indexes can be based on prorated annual costs, initial installation costs, or other systems, provided that they are expressed in units of the same scale that is used in the indexes for performance and continuing limitations.

(7) Regardless of the corrective measures applied, a soil limitation may continue to cause problems through maintenance cost, substandard performance, or offsite environmental effects. Low yields, the maintenance of water disposal systems for erosion control or drainage, use restrictions on steep slopes and maintenance or adequacy of flood control systems are examples of continuing problems. Identify continuing limitations that are associated with alternative measures and indicate by a key phrase the kind of limitation that remains. Assign an index number from a set of values that are compatible with those used for the performance standard (P) and the measure costs (CM). For some soils, the properties responsible for substandard yields may not be known. In this case, note the substandard yield as a continuing limitation without relating it to an evaluation factor and enter a cost index for CL. Exhibit 621-7 provides an example.

(8) For each corrective measure (CM) that is required to overcome an unfavorable soil factor, select the practical and locally accepted corrective measure and the local cost index for the measure and calculate the sum. Calculate the sum of the indexes for continuing limitations (CL) in the same fashion. Deduct the cost index for the measure (CM) and the cost index for the continuing limitation (CL) from the performance standard index (P) to determine the soil potential index (SPI). Exhibit 621-5 gives an example. Increase SPI as necessary to account for a performance or yield level that is above the standard. Exhibit 621-7 provides an example.

(d) All map units are arrayed from high to low according to their soil potential index. The relative ranking of soils is evaluated against local knowledge. If inconsistencies exist, the values used to arrive at SPI should be reevaluated. To arrive at rating classes, divide the final numerical array on the basis of the definition of the rating classes. The tendency of numbers in the array to cluster around certain ranges or to show natural group separations help to subdivide the array into the required classes. Exhibits 621-7, 621-8, and 621-9 give examples. It may not be desirable to indicate the numerical ratings to users because the ratings may indicate a greater degree of refinement than can be defined.

(e) For broadly defined soil map units, such as a soil association, soil potential ratings are generally prepared only for broad categories of soil use. In the evaluation for such uses, consideration is given to one or more of the individual elements that make up the use. For example, the elements of residential soil use may include dwellings, local roads and streets, and shallow excavations. The following steps are suggested:

- -- list the elements of the use being evaluated,
- -- list significant component soils and their extent in each map unit,
- -- rate each component for each element of the use according to the guides given for the phases of soil series, and
- -- evaluate the map unit for the use according to the evaluation of each element for each component, giving due consideration to the extent of and the landscape relationship of each of the components.

(f) Local regulations can affect the development of soils for some uses. If the regulations apply uniformly, soil potential ratings for cropland may include the regulated conditions as one of the rating criteria. A preferred alternative is to prepare the ratings as if there were no regulations and to footnote worksheets and final presentations to indicate those soils on which the use is prohibited by regulations. Dealings with regulated uses, such as sanitary facilities, that require approval by regulatory agencies need not be troublesome. Consideration of the alternatives and agreement on the procedures with those individuals for whom the soil potential ratings are being developed can result in useful soil potential ratings.

621.10 Terminology for Limitations and Corrective Measures.

Ratings of soil potentials should be accompanied by a statement of the corrective measures that are required to overcome soil limitations. Broad categories of corrective measures are suggested for use with ratings for broad categories of soil uses and more specific corrective measures for use with ratings for the more specific uses. The choice of phrases or terms can best be determined locally on the basis of the properties of the soils and the kinds of corrective measures needed. The following examples of limitations, broad categories of corrective measures, and more specific corrective measures illustrate differences but are not intended to dictate specific terms for use.

Limitations	Broad Categories of Corrective Measures	More Specific Corrective Measures
Wetness	Drainage	Surface drainage Tile drainage Land grading
Steep slope	Construction grading	Cuts and fills
Erodes easily	Erosion control	Vegetation Grassed waterway Terraces. Conservation tillage
High shrink-swell	Strengthened foundations	Reinforced slab Extended footings Moisture control
Floods	Flood control	Raised foundation Dikes Improved channels
Low strength	Supported foundation	Widened footings Extended footings Slab foundation
Droughty	Irrigation	Sprinkler irrigation Furrow irrigation Border irrigation Trickle irrigation

621.11 Format for Presenting Soil Potential Ratings.

(a) Soil potential ratings must be effectively presented. All presentations must include an explanation of the ratings and local definitions of the rating classes. Exhibit 621-10 provides an example. Definitions of soil uses must also be included. Regardless of the method of presentation, the worksheets and the criteria for evaluation that were used must be retained in the NRCS office as documentation of the procedures. The participating agencies, the technical specialists who participated, and the NRCS specialists are identified in all publications. Soil potential ratings are not to be used by NRCS unless the systematic procedures that are outlined in the National Soil Survey Handbook, part 621, are followed.

(1) Presentation may be in the narrative form, as in soil map unit descriptions or in tables. As a minimum, all tables and discussions must identify the soil potential rating and the corrective measures that are needed to achieve the potential of each soil map unit. Exhibits 621-11, 621-12, and 621-13 provide examples. The most desirable format identifies the soil factors that adversely affect the use, the corrective measures, and a statement on any continuing limitations. Exhibit 621-10 explains.

(2) The tables in Exhibits 621-11, 621-12, and 621-13 can be modified to meet local needs and requirements.

(3) An example of a narrative statement in a map unit description for a phase of a soil series is:
- -- "The soil has high potential for septic tank absorption fields if the field size is increased to compensate for the slow percolation rate."

(4) A narrative statement in the description of a map unit or an association might be:
- -- "This association (or map unit) has high potential for residential use if foundations are strengthened and drainage is provided on Alpha soils or if dwellings are constructed only on Beta soils."

(5) Ratings for soil potential can be shown on colored maps; however, they must be supported by tabular or narrative presentations that identify the corrective measures needed to achieve the potential and that provide definitions of the soil uses and rating classes.

Exhibit 621-1 Analysis of Preparations and Procedures for Soil Potential Ratings.

PREPARATIONS OF SOIL POTENTIAL RATINGS

Design

Prepare and design with interdisciplinary input
--agricultural uses ---------- required
--nonagricultural uses ---------- required

Prepare and design ratings for map units ---------- required

Prepare and design ratings for named components of map units ---------- required

Follow a systematic procedure ---------- required

Procedures

Rate all soils in area for a given use ---------- required

Give size of area for which ratings are prepared, such as town, county, state, and MLRA. ---------- optional

Follow given steps in preparation ---------- required

Have data available on soils, corrective measures, performance, and continuing limitations ---------- required

Prepare plan for obtaining data if data are inadequate ---------- required
Give values for P, such as magnitude of base number ---------- optional
Define soil use ---------- required
Prepare evaluation criteria ---------- required
Use regulations as rating criteria ---------- optional
Establish performance standard ---------- required
Assign limitation ratings to criteria ---------- optional
Use a worksheet ---------- required
Use sample worksheet ---------- optional
Use index numbers not dollars, and bushels. ---------- optional
Retain worksheet as documentation of procedures ---------- required
Prepare key phrases for corrective measures and continuing limitations ---------- suggested

Presentation to Users

--Provide in maps and tables, or in map unit descriptions ------------------------- optional
--Use definitions of soil potential ratings -- required
--Use terms and definitions of rating classes --------------------------------------- required
--Provide definition of rated use -- required
--Identify agencies and give names of
participating local experts -- required
--Show corrective measures (except on maps) ----------------------------------- required
--Show continuing limitations -- optional/suggested
--Avoid presentation of uncoordinated ratings ----------------------------------- required
--Avoid repetition of limitation ratings for same
soil use in other tables in same report -- suggested
--Provide users with numerical indices --- optional
--Use given format of tables -- optional

Exhibit 621-2 Soil Potential Ratings for Forest Land (Beta County).

Definition:

Soils managed for maximum average yearly growth per acre (cubic feet), assuming established stands for loblolly pine if adapted, otherwise the best adapted hardwood, not fertilized or irrigated.

Yield standard:

130 cubic feet per acre average yearly growth. The yield standard of 130 cubic feet per acre per year is set on the basis of the production of a locally preferred forest land species on productive soils that are common to the area.

Evaluating Criteria:

Depth to water table (inches)
Flooding
Slope (percent)
Surface texture
Available water capacity

Cost Index:

A percentage of the value of the harvested crop rounded to the nearest whole number is used. Cost classes representing ranges of values are not used.

Performance Index:

100 (equivalent to the yield standard of 130 cubic feet per acre per year)

Exhibit 621-3 Soil Potential for Dwellings Without Basements.

Definition:

Single-family residences; 1,400 to 1,800 square feet of living area; without basements; spread footings or slab construction, or both; life span of 50 years; and intensive use of yard for lawns, gardens, landscaping, and play areas. Ratings assume adequate waste disposal and lot sizes of one-fourth acre or less.

Evaluating Criteria:

Depth to water table (inches)
Flooding
Slope (percent)
Shrink-swell potential

Cost Index:

Index value1/	Cost classes for corrective measures and continuing limitations (dollars)2/
1	<250
2	250-500
4	500-1,000
8	1,000-2,000
12	2,000-3,000
16	3,000-4,000
20	4,000-5,000

1/ Index values in this example are arbitrarily set at 0.4 percent of the upper limit of each cost class.

2/ To be compatible with costs of corrective measures, the cost of continuing limitations is established for the 50-year life span of the dwelling.

Exhibit 621-4 List of Corrective Measures and Cost.

This exhibit shows how local data might be summarized and made available as a ready reference for preparing soil potential ratings. Corrective measures likely to be needed can be anticipated and costs established for each. As soil potential ratings are prepared, additional measures may be identified that should be added to the list. The general technique applies to both agricultural and nonagricultural soil uses.

This example is only to illustrate a procedure. The corrective measures and costs that are shown are examples only and should not be used without modification to fit local situations.

The following list gives the corrective measures and costs for dwellings without basements. Corrective measures are those that overcome or minimize soil limitations identified in evaluating criteria. Costs are based on an arbitrary foundation area of local standards that is approximately 1,200 square feet. The costs are in excess of those for standard design where no soil limitations are identified. Index values are 1 percent of the range midpoint of estimated costs.

Corrective Measures	Cost (dollars)	Index
Drainage of footing	300-500	4
Drainage of footing and slab	600-800	7
Excavation and grading		
8-15 percent slope	100-300	2
15-30 percent slope	300-500	4
Rock Excavation and disposal (fractured limestone)		
0-8 percent slope	1,000-1,400	12
8-15 percent slope	700-900	8
Reinforced slab		
moderate shrink-swell potential	1,500-2,000	17
high shrink-swell potential	3,600-4,200	39
Area wide surface drainage (per lot)	100-200	2
Importing topsoil for garden and lawn	1,000-1,400	11

Examples of the application of cost index are:

(a) Soil on 8 to 15 percent slopes with high shrink-swell potential requires:

Reinforced slab	39
Excavation and grading	2
CM =	41

(b) Soil on 0 to 1 percent slope with high water table requires:

Area-wide surface drainage	2
Drainage for footing and slab	7
CM =	9

Exhibit 621-5 Worksheet for Preparing Soil Potential Ratings.

Exhibit 621-6 Explanation of Worksheets for Preparing Soil Potential Ratings for Forest Land (Beta County).

(a) A worksheet is prepared for each soil map unit.

(b) The yield standard (130) is adjusted to a standard performance index of 100 to provide a range of soil potential indexes from 0 to 100. Productivity of 130 cubic feet per acre (loblolly pine, site index 90) meets the standard performance index of 100, such as in the Alpha and Beta map units. Productivity of 110 cubic feet per acre (loblolly pine, site index 80) is substandard performance SPI = 110/130 x 100 (SPI = 85), and is considered a continuing limitation if corrective measures fail to overcome the yield limitation, such as in the Gamma and Sigma map units. Productivity of 152 cubic feet per acre (loblolly pine, site index 100) is performance above the yield standard, SPI = 152/130 x 100 (SPI = 117), and SPI increases, such as in the Omega map unit.

(c) Enter evaluation factors from the table of rating criteria prepared for the soil use, as in Exhibit 621-1.

(d) Enter soil and site conditions for the map unit for each evaluation factor. Enter the degree of limitation from the table of evaluation criteria, as in Exhibit 621-1.

(e) Enter the effects of the soil and site conditions to provide a basis for the identification of corrective measures.

(f) Enter feasible alternative measures for overcoming the effects of limiting soil or site conditions. Technical guides are useful references. Note that measures are identified wherever possible to overcome the effects of limitations in preference to leaving the problem as an unresolved continuing limitation.

(g) In this example, index values for measures and continuing limitations are a percentage of the value of the harvested crops. Whether the costs occur only one time or several times in the period between planting and harvest is considered.

(h) The factor that accounts for substandard yield of the Sigma soil is not known. The substandard yield is noted as a continuing limitation without relation to a soil factor.

(i) Index values for corrective measures (CM) and continuing limitations (CL) are summed and deducted from the performance standard index (P) to determine the soil potential index (SPI).

(j) The soil potential indexes are arrayed and the ratings are assigned as follows:

117	Very high	Omega silt loam
100	High	Beta fine sandy loam, 1 to 3 percent slopes
85	High	Alpha silt loam
78	Medium	Gamma loamy fine sand, 8 to 13 percent slopes
77	Medium	Sigma fine sandy loam, 15 to 25 percent slopes

Exhibit 621-7 Worksheet for Preparing Soil Potential Ratings for Forest Land (Beta County).

Exhibit 621-8 Worksheet for Preparing Soil Potential Ratings for Septic Tank Absorption Fields (Sigma County).

Exhibit 621-9 Worksheet for Preparing Soil Potential Ratings for Dwellings Without Basements (Alpha County).

Exhibit 621-10 Explanation of Soil Potential Ratings for Maps or Reports.

(a) The soil potential ratings indicate the comparative quality of each soil in the county for the specified uses. Because comparisons are made only among soils in this county, ratings for a given soil in another county may differ.

(b) Potential ratings are based on a system developed for a given county and include consideration of (1) yield or performance levels, (2) the difficulty or relative cost of corrective measures that can improve soil performance or yield, and (3) any adverse social, economic, or environmental consequence that cannot be easily overcome.

(c) The ratings do not constitute recommendations for soil use. They are to assist individuals, planning commissions, and others in arriving at wise land use decisions. Treatment measures are intended as a guide to planning and are not to be applied at a specific location without onsite investigations for design and installation.

(d) The soil potential ratings used are defined as follows: (the definitions of those soil potential ratings used are inserted.)

Exhibit 621-11 Soil Potential Ratings for Septic Tank Absorption Fields.

Soil Name and Map Symbol	Limitations and Restrictions	Soil Potential and Corrective Treatment	Continuing Limitations
1--Grenada silt loam, 0 to 2 percent slopes	Severe: percs slowly.	Medium: conventional system, alternate valve, large field, pump tank in wet season.	Monitor system for need to pump.
2--Jefferson gravelly loam, 5 to 10 percent slopes	Slight	Very high: conventional system, small field.	None.
3--Linsdale silt loam, 0 to 2 percent slopes	Severe: wetness.	High: conventional system, medium field, area-wide subsurface drainage.	Maintain drainage system.
4--Memphis silt loam, 2 to 6 percent slopes	Slight	High: conventional system, medium field.	None.
5--Memphis silt loam, 12 to 20 percent slopes	Moderate: slope.	High: conventional system, medium field, slope design.	None.
6--Memphis silt loam, 25 to 30 percent slopes	Severe: slope.	Very low: no known system.	---
7--Talbott silt loam, 8 to 12 percent slopes	Severe: percs slowly, depth to rock.	Low: mound system.	None.
8--Waverly silt loam, 0 to 2 percent slopes	Severe: wetness.	Low: mound system.	None.

Exhibit 621-12. Soil Potential Ratings for Cropland.

Soil Name and Map Symbol	Soil Potential and Corrective Treatment	Continuing Limitations
1--Caddo silt loam, 0 to 1 percent slopes	High: drainage, high fertilization rate.	Maintenance of drainage system.
2--Gore fine sandy loam 8 to 12 percent slopes	Low: erosion control.	Maintenance of erosion control system, substandard yield.
3--Guyton silt loam	Medium: drainage, high fertilization rate	Maintenance of drainage system.
4--Guyton silt loam, frequently flooded	Very low: project-type flood control, drainage	Maintenance of drainage and flood control system.
5--Kisatchie soils, 15 to 30 percent soils	Very low: erosion control, high fertilization rate.	Maintenance of erosion control system, equipment limitations substandard yield.
6--Norwood silt loam	Very high: drainage.	Maintenance of drainage system.
7--Ruston fine sandy loam, 3 to 5 percent slopes	High: erosion control.	Maintenance of erosion control system.
8--Ruston fine sandy loam, 8 to 12 percent slopes	Low: erosion control.	Maintenance of erosion control system, substandard yield.

Exhibit 621-13 Soil Potential Ratings and Corrective Measures for Cropland, Pastureland, Forest Land, and Residential Land.

Soil Name	Cropland	Pastureland	Forest land	Residential land
1--Caddo silt loam, 0-1 percent slopes	High: drainage.	High: drainage, scheduled grazing avoid wet conditions.	High: scheduled operations to avoid wetness.	Medium: drainage
2--Core fine sandy loam, 8 to 12	Low: erosion control.	Medium: erosion control.	Medium: scheduled operations to avoid wet conditions.	Medium: construction grading, water disposal, strengthened foundation.
3--Guyton silt loam	Medium: drainage.	Medium: drainage, scheduled grazing to avoid wet conditions.	High: scheduled operations to avoid wet conditions.	Low: drainage diversions.
4--Guyton silt loam, frequently flooded	Very low: project-type flood control.	Low: drainage, adapted water tolerant plants, scheduled grazing to avoid wet conditions.	High: scheduled operations to avoid wet conditions.	Very low: project type flood control, drainage.
5--Kisatchie soils, 15 to 30 percent slopes	Very low [1/]:	Low: reduced stocking rates.	Low: erosion control during site preparation and logging.	Low: construction grading, water disposal excavate rock.
6--Norwood silt loam	Very high:	Very high:	Very high	Very high
7--Ruston fine sandy loam, 3 to 8 percent slopes	High: erosion control.	Very high:	High	Very high
8--Ruston fine sandy loam, 8 to 12 percent slopes	Low: erosion control.	Very high:	High	High: construction grading, water disposal.

[1/] Soil conditions are such that treatments are generally not warranted for this use.

Soil Use: Area:

Mapping Unit:

Evaluation Factors	Soil and Site Conditions	Degree of Limitation	Effects On Use	Corrective Measures		Continuing Limitations	
				Kinds	Index	Kind	Index
				Total		Total	

______ Performance Standard Index - ______ Measure Cost Index - ______ Continuing Limitation Cost Index = ______ Soil Potential Index[1/]

[1/] If performance exceeds the standard increase SPI by that amount.

Soil Use: Forest Land

Area: Beta County

Yield standard 130 ft^3 /ac/yr

Mapping Unit: Sigma fine sandy loam, 15 to 25 percent slopes

Yield estimate 110 ft^3 /ac/yr

Evaluation Factors	Soil and Site Conditions	Degree of Limitation	Effects On Use	Corrective Measures		Continuing Limitations	
				Kinds	Index	Kind	Index
Slope (percent)	15-25%	Moderate	Equipment limitation, Erosion	Safety Precautions 2/	4	None	1
				Road design	3	Road Maintenance	
Depth to high water table (ft.)	>2'	Slight	None				
Flooding	None	Slight	None				
Available water capacity (5 ft. depth)	>8"	Slight	None				
Surface texture	Loamy	Slight	None				
						Moderate yield 3/	15
				Total	7	Total	16

2/ Special equipment not considered practical.
3/ Substandard yield not accounted for in evaluation factors. Corrective measures not known. Yield is 15% below standard.

100	-	7	-	16	=	77
Performance Standard Index		Measure Cost Index		Continuing Limitation Cost Index		Soil Potential Index 1/

1/ If performance exceeds the standard increase SPI by that amount.

Soil Use: Septic tank absorption fields Area: Sigma County

Mapping Unit: Alpha silt loam, 12 to 20 percent slopes

Evaluation Factors 2/	Soil and Site Conditions	2/ Degree of Limitation	Effects On Use	Corrective Measures		Continuing Limitations	
				Kinds	Index	Kind	Index
Percolation rate	45 min/in	Slight	None	Conventional system medium field 3/	0	None	0
Water table	>6'	Slight	None				
Flooding	None	Slight	None				
Slope	12-20%	Moderate	Surface seepage	Slope design	10 4/	None	0
Stoniness	None	Slight	None				
Depth to rock or other impervious material	>6'	Slight	None				
				Total	10	Total	0

2/ Local factors and ratings.
3/ This system is the standard installation.
4/ Index number is percent above standard installation cost.

100	-	7	-	0	=	90
Performance Standard Index		Measure Cost Index		Continuing Limitation Cost Index		Soil Potential Index 1/

1/ If performance exceeds the standard increase SPI by that amount.

Soil Use: Dwellings without basements	Area: Alpha County

Mapping Unit: Beta silt loam

Evaluation Factors 2/	Soil and Site Conditions	2/ Degree of Limitation	Effects On Use	Corrective Measures Kinds	Corrective Measures Index	Continuing Limitations Kind	Continuing Limitations Index
Depth to high water table	0-2' (perched)	Severe	Wet lawns Construction Problems	Surface drainage Special drainage during construction	2 4	Maintain drainage yard use restrictions in wet seasons	1 6
Flooding	None	Slight	None				
Slope	0-1%	Slight	None	Slope design	10	None	0
Shrink-swell	Low	Slight	None				
				Total	6	Total	7

100 Performance Standard Index - 6 Measure Cost Index - 7 Continuing Limitation Cost Index = 87 Soil Potential Index[1]

[1] If performance exceeds the standard increase SPI by that amount.

Part 622 - ECOLOGICAL AND INTERPRETATIVE GROUPS

CONTENTS

622.00 Definition.

Ecological and interpretative groups are specified land use and specific management groupings that are assigned to soil areas because combinations of soils have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. They allow users of soil surveys to plan reasonable alternatives for the use and management of soils.

622.01 Policy and Responsibilities.

The soil criteria used to determine the rating is coordinated nationally. Data elements, classes, or groups that are used in national legislation have strict adherence to national procedures. Guides that are developed locally or by states to rate soil survey land classification and groups are reviewed according to the procedure discussed in part 617.05. Prime farmland, hydrologic soil groups, and other Interpretative groups important to many different users are published in the soil survey report.

The state soil scientist is responsible for program specific and state interpretative group assignments to soil map units. The state soil scientist ensures that all nationally significant interpretative group assignments to map units are included in the national soil information system.

622.02 Land Capability Classification.

(a) Definition. Land capability classification is a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time.

(b) Classes. Land capability classification is subdivided into capability class and capability subclass nationally. Some states utilize a capability unit.

(c) Significance. Land capability classification has a value as a grouping of soils. National Resource Inventory information and many field office technical guides have been assembled according to these classes. The system has been adopted in many textbooks and has public acceptance. Some state legislation has used the system for various applications. Users should reference Agriculture Handbook No. 210 (Exhibit 622-2) for a listing of assumptions and broad wording used to define the capability class and capability subclass.

(d) Application.

All map unit components are assigned a capability class and subclass. Agriculture Handbook No. 210 (Exhibit 622-2) provides general guidance, and individual state guides provide assignments of the class and subclass applicable to the state. Land capability units can be used to differentiate subclasses at the discretion of the state. Capability class and subclass are assigned to map unit components in the national soil information system.

(e) Categories.

(1) Capability Class.

(i) Definition. Capability class is the broadest category in the land capability classification system. Class codes 1, 2, 3, 4, 5, 6, 7, and 8 are used to represent both irrigated and nonirrigated land capability classes.

(ii) Classes and definitions.

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
Class 4 soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
Class 5 soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
Class 6 soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
Class 7 soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
Class 8 soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.

(2) Capability Subclass.

(i) Definition. Capability subclass is the second category in the land capability classification system. Class codes e, w, s, and c are used for land capability subclasses.

(ii) Subclasses and definitions.

Subclass **e** is made up of soils for which the susceptibility to erosion is the dominant problem or hazard affecting their use. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass.
Subclass **w** is made up of soils for which excess water is the dominant hazard or limitation affecting their use. Poor soil drainage, wetness, a high water table, and overflow are the factors that affect soils in this subclass.
Subclass **s** is made up of soils that have soil limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.
Subclass **c** is made up of soils for which the climate (the temperature or lack of moisture) is the major hazard or limitation affecting their use.

(iii) Application. The subclass represents the dominant limitation that determines the capability class. Within a capability class, where the kinds of limitations are essentially equal, the subclasses have the following priority: e, w, s, and c. Subclasses are not assigned to soils or miscellaneous areas in capability classes 1 and 8.

(3) Capability Unit.

(i) Definition. Capability unit is the third category in the land capability classification system. It is a grouping of one or more individual soil mapping units having similar potentials and continuing limitations or hazards.

(ii) Application. Use of this category and definition of codes are state options. Valid entries in NASIS are integers ranging from 1 to 99.

(f) Entries. Enter the appropriate capability class and subclass code for each map unit component. Enter the appropriate capability unit code, if one is to be used in the area. Allowable entries for capability class are 1, 2, 3, 4, 5, 6, 7, or 8. Allowable entries for subclass are e, w, s, or c. Enter subclass for all classes except 1 and 8. Valid entries for capability unit are integers ranging from 1 to 99. Nonirrigated land capability classes and subclasses should be entered for all soils. Enter the irrigated land capability class and subclass if the soil component is irrigated or potentially will be irrigated.

622.03 Farmland Classification.

(a) Definition. The farmland classification identifies map units as prime farmland, farmland of statewide importance, or farmland of local importance.

(b) Significance. Farmland classification identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. This identification is useful in the management and maintenance of the resource base that supports the productive capacity of American agriculture.

(c) Measurement. NRCS policy and procedures on prime and unique farmlands are published in the Code of Federal Regulations 7CFR657.. This regulation is reproduced in Exhibit 622-1 for convenience. The web site is: *http://www.access.gpo.gov/nara/cfr/waisidx_99/7cfr657_99.html*

(d) Entries. Enter the numerical code for the classification of each map unit. Soils of unique, statewide, or local importance are not prime farmland. Allowable entries are numerical codes as follows:

0 - Not prime farmland.
1 - All areas are prime farmland.
2 - Prime farmland if drained.
3 - Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 - Prime farmland if irrigated.
5 - Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
6 - Prime farmland if irrigated and drained.
7 - Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season.
8 - Prime farmland if subsoiled, completely removed the root inhibiting soil layer.
9 - Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60.
10 - Prime farmland if irrigated and reclaimed from excess salts and sodium.
30 - Farmland of statewide importance.
50 - Farmland of local importance.
70 - Farmland of unique importance.

622.04 Prime Farmland Soils.

(a) Definition.

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding. Users of the lists of prime farmland map units should recognize that soil properties are only one of several criteria that are necessary. Other considerations include:

(1) Land use - Prime farmland is designated independently of current land use, but it cannot be areas of water or urban or built-up land as defined for the National Resource Inventories. Map units that are complexes or associations containing components of urban land or miscellaneous areas as part of the map unit name cannot be designated as prime farmland. The soil survey memorandum of understanding determines the scale of mapping and should reflect local land use interests in designing of map units.

(2) Frequency of flooding - Some map units may include both prime farmland and land not prime farmland because of variations in flooding frequency.

(3) Irrigation - Some map units include areas that have a developed irrigation water supply that is dependable and of adequate quality and areas that do not have such a supply. In these units, only the irrigated areas meet the prime farmland criteria.

(4) Water table - Some map units include both drained and undrained areas. Only the drained areas meet the prime farmland criteria.

(5) Wind erodibility - The product of I (soil erodibility) x C (climate factor) cannot exceed 60 to meet prime farmland criteria. A map unit may be considered prime farmland in one part of a survey area but not in another where the climate factor is different.

(b) Purpose.

The Natural Resources Conservation Service (NRCS) is committed to the management and maintenance of the resource base that supports the productive capacity of American agriculture. This management and maintenance includes identifying of the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. Prime farmland information may be supplemented with separate designations of soil map units that have state-wide, local, or unique importance as farmland capable of producing these crops.

(c) Code of Federal Regulations.
NRCS policy and procedures on prime and unique farmlands are published in the Code of Federal Regulations 7CFR657. The content is reproduced in Exhibit 622-1 for convenience. The web site is: *http://www.access.gpo.gov/nara/cfr/waisidx_99/7cfr657_99.html*

(d) Policy.
State soil scientists prepare and maintain an up-to-date list of soil survey map units that meet the soil criteria for prime farmland. The list given in field office technical guides for users concerned with only a single area is a subset of the state list. The list of prime farmland soils should be kept up-to-date. The state soil scientist ensures that prime farmland soil interpretations are made for all soil mapping units in that state. Mapping units continuing across state lines should be coordinated with the adjoining state. Other policy guidance is given in part 510 of the National Inventory and Monitoring Manual.

(e) List of Prime Farmland Map Units.
Soil survey map units that meet the soil requirements for prime farmland are to be identified, coordinated, and listed. The list or its subset is to be available to users of soil survey information.

(f) Quality Control of Prime Farmland Map Units.
(1) Computer generation of prime farmland map units in each state is based on guidelines provided by the National Soil Survey Center. The guidelines provide checks to identify concerns in the classification of prime farmland based on soil properties. The computer checks can be used for guidance but do not suffice as the sole determinant for prime farmland map units.
(2) Each prime farmland map unit must be documented, either by the computer check or by a statement of reasons that explain the decision.
(3) Some soil survey map units may meet the soil criteria for prime farmland, but additional investigation is needed before a final determination is made. The measures needed to qualify the soil as prime farmland are indicated by an appropriate footnote or in a parenthetic statement of explanation that follows the map unit name on the list.

622.05 Highly Erodible Land - Highly Erodible Soil Map Unit List.

(a) Definition.
Highly erodible land is defined by the Sodbuster, Conservation Reserve, and Conservation Compliance parts of the Food Security Act of 1985 and the Food, Agriculture, Conservation, and Trade Act of 1990. Determinations for highly erodible land are based on an erodibility index as defined in the National Food Security Act Manual.

(b) Policy.
Lists of highly erodible and potential highly erodible map units are maintained in the field office technical guide. Policy and procedures for developing and maintaining the lists are given in part 511 of the National Food Security Act Manual.

622.06 Hydric Soils.

(a) Definition.
A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils along with hydrophytic vegetation and wetland hydrology are used to define wetlands.

(b) Policy.
The current criteria for generating a list of hydric soils is in the Federal Register, September 18, 2002, volume 67, number 181, page 58756 The reference for field identification of hydric soils is Field Indicators of Hydric Soils of the United States, Version 5.01 2003. (http://soils.usda.gov/use/hydric).

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States maintain current lists of hydric soil map units in the field office technical guide.

622.07 Ecological Sites.

(a) Definition.

An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. An ecological site is recognized and described on the basis of the characteristics that differentiate it from other sites in its ability to produce and support a characteristic plant community.

Forestland ecological sites and rangeland ecological sites are separated based on the historic climax plant community that existed at the time of European immigration and settlement. A site type of "forestland" is assigned and described where a 25% overstory canopy of trees, as determined by crown perimeter-vertical projection, dominated this historic vegetation. A site type of "rangeland" is assigned where overstory tree production was not significant in the climax vegetation. Refer to the National Forestry Manual (ftp://ftp-fc.sc.egov.usda.gov/NSSC/National_Forestry_Manual/2002_nfm_complete.pdf) and the National Range and Pasture Handbook (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html) for details on developing ecological site descriptions.

(b) Policy

Soil-ecological site correlation establishes the relationship between soil components and ecological sites. Ecological sites are correlated on the basis of soils and the resulting differences in species composition, proportion of species, and total production of the historic climax plant community. Sometimes it is necessary to extrapolate data on the composition and production of a plant community on one soil to describe the plant community on a similar soil for which no data are available. The separation of two distinct soil taxonomic units does not necessarily delineate two ecological sites. Likewise, some soil taxonomic units occur over broad environmental gradients and may support more than one distinctive historic climax plant community. Changes may be brought about by other influences, such as an increase or decrease in average annual precipitation.

Ecological sites are to be correlated between states. Only one Site ID should be given to a single site that occurs in adjacent states within the same MLRA. Refer to the National Forestry Manual (ftp://ftp-fc.sc.egov.usda.gov/NSSC/National_Forestry_Manual/2002_nfm_complete.pdf) and the National Range and Pasture Handbook (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html) for details on the policy for correlating ecological sites.

(c) Responsibilities.

Soil scientists and the responsible discipline specialists work together to map soils and ecological sites. Essential activities include development of soil survey memorandum of understanding (work plan), determination of composition of soil mapping units, preparation of map legends, determination of mapping intensity, and conducting necessary field reviews. State discipline specialists have the final responsibility for correlating ecological sites to the map unit component to ensure coordination among states and land use areas.

622.08 Windbreaks.

(a) Definition.

A windbreak is a living barrier of trees or a combination of trees and shrubs that is located adjacent to a farmstead, field, feedlot, or other area. It is established to protect soil resources, reduce wind erosion, conserve energy or moisture, control snow deposition, provide shelter for livestock or wildlife, or increase the natural beauty of an area. It is also called a field windbreak, feedlot windbreak, or farmstead windbreak, depending upon its intended use. Field windbreaks, often called shelterbelts, are long, narrow strips of trees and shrubs that are planted in a variety of patterns to check the movement of wind.

(b) Policy.

Soil interpretations are made for all soils in all areas where windbreaks are a present or potential practice. These interpretations are to be included in field office technical guides, soil handbooks, and published soil surveys.

Refer to the National Forestry Manual for forestland interpretations. Conservation Tree/Shrub Group is a forestland interpretation useful for windbreak planning.

Soil scientists work with foresters in preparing windbreak interpretations.

622.09 Wildlife Habitat.

(a) Definition.

The habitat of a particular animal is defined as the place where the animal lives. Each habitat is the entire environmental complex, both living and nonliving, that is present at the place occupied by the animal species. Soils are rated in their described condition and do not consider existing vegetation, water sources, or the presence or absence of wildlife in the area. These factors need to be considered during the site evaluation and planning process in order to obtain total habitat quality.

(b) Policy.

Soil interpretations can be developed for all soils that have the potential to provide some form of habitat to locally adapted wildlife species. Soil scientists and biologists work together to identify specific wildlife habitat elements and to develop the categorical lists for the local area. This information is based on the inherent capabilities of the soil to produce certain kinds of vegetation for use as wildlife habitat or as habitat that meets specific requirements of an animal species. The National Biology Manual provides more information.

622.10 Plant Name, Common

(a) Definition. The common plant name is the common name, accepted by the state or region, for the plant species or genera.

(b) Entries. None required. The common plant name used in that state will be provided by the system from the PLANTS database (http://plants.usda.gov/) to match the plant symbol entered elsewhere. Adjustment or additions can be made.

622.11 Plant Name, Scientific.

(a) Definition. Scientific plant name is the full genus and species name with author. Refer to "PLANTS," Plant List of Accepted Nomenclature, Taxonomy, and Symbols.

(b) Significance. This information is important for technology transfer and interchange.

(c) Entries. None required. The system will provide the scientific plant name to match the plant symbol entered elsewhere.

622.12 Ecosystem ID

(a) Definition. Ecosystem ID is an identifier that, in conjunction with "ecosystem type," uniquely identifies a particular ecosystem. For example, for range sites, the combination of ecosystem type = rangeland and ecosystem id = rangesite id uniquely identifies a particular rangesite.

(b) Entries. Enter the unique ID for the ecosystem for each map unit component where needed. Valid entries are combinations of numbers and/or letters up to 10 characters in length.

622.13 Ecosystem Name.

(a) Definition. Ecosystem name is the descriptive name of a particular ecosystem. For example, "loamy upland" is a name of a range site.

(b) Entries. Enter the appropriate name of the ecosystem for each map unit component where needed.

622.14 Ecosystem Type.

(a) Definition. Ecosystem type is the type of ecosystem.

(b) Classes.

<u>choice</u>
grazeable forest
hayland
native pasture
pasture
rangesite

(c) Entries. Enter the class name for each map unit component where needed.

622.15 Earth Cover, Kind

(a) Definition. Earth cover, kind, is the natural or artificial material that is observed to cover a portion of the Earth's surface. It is determined (at least conceptually) as a vertical projection downward. There are two levels of categories.

(b) Significance. Earth cover, kind, is useful in assessing soils for use and management and monitoring for soil health. Earth cover kind is important in linking to National Resources Inventory (NRI) data.

Soil data ranges included in the map unit records in NASIS may be narrowed by indicating the cover type present for each map unit component.

Significant differences for interpretations between the major cover types can be shown by splitting the map unit component into these cover types.

Earth cover is divided into two levels -- the second being a subdivision of the first.

(c) Earth Cover Level 1 Classes. These correspond to the Level 1 categories used in the National Resources Inventory "Instructions for Collecting 1992 National Resources Inventory Sample Data." The definitions have been slightly altered.

Crop Cover	The full cropping cycle, including land preparation and post-harvest residue cover of annual or perennial herbaceous plants that are cultivated or harvested, or both, for the production of food, feed, oil, and fiber other than wood, and excluding hay and pasture.
Grass/ Herbaceous Cover	(>50% grass, grass-like, or forb cover) Non-woody vegetative cover composed of annual or perennial grasses, grasslike plants (sedges/rushes), forbs (including alfalfa and clovers), mosses, lichens, and ferns.
Tree Cover	(>25% tree canopy cover) Vegetative cover recognized as woody plants which usually have one perennial stem, a definitely formed crown of foliage, and a mature height of at least 4 meters. This category contains all trees, even those planted for the purpose of producing food or ornamentals, including Christmas trees. It also includes those lands which have been harvested of trees, even those that have been clear cut, but will return to tree cover.
Shrub Cover	(>50% shrub canopy cover) Vegetative cover composed of multi-stemmed, woody plants and single-stemmed species that attain less than 4 meters in height at maturity. This category contains all shrubs and woody vines, even those planted for the purpose of producing food.

Barren land	Nonvegetative (<5% vegetated cover) natural cover often having a limited capacity to support vegetation, with a surface of sand, rock, thin soil, or permanent ice or snow. This category also includes bare soil resulting from construction activities and extractive activities such as mining.
Artificial Cover	Nonvegetative cover either made or modified by human activity that prohibit or restrict vegetative growth and water penetration. Examples include highways, rooftops, road surfaces, paved and stone surface parking areas, sidewalks, and driveways.
Water	Earth covered by water in a fluid state. This category includes seasonally frozen areas.

CODE	CLASS
C	Crop cover
G	Grass/Herbaceous cover
T	Tree cover
S	Shrub cover
B	Barren land
A	Artificial cover
W	Water cover

(d) Earth Cover Level 2 classes. These are subdivisions of Level 1 classes.

Level 1	Level 2
Crop Cover	Row crops (corn, soybeans, cotton, tomatoes and other truck crops, and tulips)
	Close-grown crops (wheat, rice, oats, and rye)
Grass/herbaceous cover	Rangeland, grassland (<10% trees, <20% shrubs). This subdivision includes rangeland used for hayland, including bluestems, mixed midgrasses and shortgrasses.
	Rangeland, savanna (10 to 25% tree cover)
	Rangeland, shrubby (20 to 50% shrub cover)
	Rangeland, tundra
	Pastureland, tame (fescues, bromegrass, timothy, and lespedeza)
	Hayland (fescues, bromegrass, timothy, and alfalfa)
	Marshland (grasses and grass-like plants)
	Other plants.
Tree cover	Crop trees (apples, pecans, date palms, citrus, ornamental nursery stock, and Christmas trees)
	Conifers (spruce, pines, and Douglas fir)
	Hardwoods (oak, hickory, elm, and aspen)
	Intermixed conifers and hardwoods (oak-pine mix)
	Tropical (mangrove and royal palms)

	Swamp (trees and shrubs)
	Other
Shrub cover	Crop shrubs (filberts, blueberry, and ornamentals used as nursery stock)
	Crop vines (grapes, blackberries, and raspberries)
	Native shrubs (creosote bush, shrub live oak, sagebrush, and mesquite, includes rangeland with >50% shrub cover)
	Other
Barren	Rock
	Sand and gravel
	Culturally induced (saline seeps, mines, quarries, and areas of oil-waste)
	Permanent snow and ice
	Other (salt flats, slickspots, mud flats, and badlands)
Artificial cover	Rural transportation (highways, and railroads.)
	Urban and built-up (cities, towns, farmsteads, and industrial sites)
Water	

(e) Entries. Enter the applicable Level 1 class for each map unit component. Enter the applicable Level 2 class as appropriate.

Exhibit 622-1 Prime and Unique Farmlands.

The Code of Federal Regulations for title 7 part 657 are maintained in the following web site. http://www.gpoaccess.gov/cfr/index.htmlThe January 1, 1999 version was amended on September 25, 2000 with the changes published in the Federal Register as follows:
[Federal Register: September 25, 2000 (Volume 65, Number 186)]
[Rules and Regulations]
[Page 57537-57538]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr25se00-2]

DEPARTMENT OF AGRICULTURE

Natural Resources Conservation Service

7 CFR Part 657

Prime and Unique Farmlands--Important Farmlands Inventory

AGENCY: Natural Resources Conservation Service, Agriculture.

ACTION: Final rule.

SUMMARY: The Natural Resources Conservation Service is amending its regulations regarding responsibilities for conducting important farmland inventories under the Federal Crop Insurance Reform and Department of Agriculture Reorganization Act of 1994 (the 1994 Act). The amendments reflect changes to individual and organizational titles made since the regulations were originally drafted.

EFFECTIVE DATE: September 25, 2000.

FOR FURTHER INFORMATION CONTACT: Horace Smith, Division Director, Soil Survey Division, Natural Resources Conservation Service, P.O. Box 2890, Washington, D.C. 20013; 202-720-1820.

SUPPLEMENTARY INFORMATION: This final rule makes corrections to nomenclature in the regulations for conducting important farmland inventories (7 CFR

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Part 657, Subpart A.) Since the implementing legislation was passed, the names of the offices and titles of officials charged with conducting important farmland inventories have changed. This amendment reflects those changes. In addition, this rule amends the authority citation to clarify the list of statutory authorities for the inventories.

These rules are not expected to have significant economic impact under the criteria of the Regulatory Flexibility Act. They will not impose information collection requirements under the provisions of the Paperwork Reduction Act of 1980, 44 U.S.C. Chapter 35.

List of Subjects in 7 CFR Part 657

Farmlands.

For the reasons set forth above, Subpart A, Part 657 of Chapter VI of Title 7 of the Code of Federal Regulations is amended as follows:

PART 657--PRIME AND UNIQUE FARMLAND

Subpart A--Important Farmlands Inventory

1. The authority citation for Subpart A, Part 657 is revised to read as follows:

Authority: 7 U.S.C. 1010a; 16 U.S.C. 590a-590f; 42 U.S.C. 3271-3274.

Sec. 657.4 [Amended]

2. Section 657.4(a)(3)(iii) is amended by revising ``NRCS Technical Service Centers (TSC's). (See 7 600.3, 600.6)" to read ``National Soil Survey Center. (see 7 CFR 600.2(c), 600.6)".

3. Section 657.4(a)(4) is amended by revising the first sentence to read as follows: ``Coordinate soil mapping units that qualify as prime farmlands with adjacent States, including Major Land Resource Area Offices (see 7 CFR 600.4, 600.7) responsible for the soil series."

4. Section 657.4(a)(6) is amended by revising ``Administrator" to read ``Chief".

5. Section 657.4(b) is amended by revising the heading and the first sentence to read as follows: ``National Soil Survey Center. The National Soil Survey Center is to provide requested technical assistance to State Conservationists and Major Land Resource Area Offices in inventorying prime and unique farmlands (see 7 CFR 600.2(c)(1), 600.4, 600.7)."

6. Section 657.4(c) is amended by revising ``Assistant Administrator for Field Services (See 7 CFR 600.2)" to read ``Deputy Chief for Soil Survey and Resource Assessment (see 7 CFR 600.2(b)(3))".

Signed in Washington, D.C. on September 14, 2000.
Pearlie S. Reed,
Chief.
[FR Doc. 00-24525 Filed 9-22-00; 8:45 am]
BILLING CODE 3410-16-P

Title 7--Agriculture

CHAPTER VI--NATURAL RESOURCES CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE

PART 657--PRIME AND UNIQUE FARMLANDS

[Code of Federal Regulations]
[Title 7, Volume 6, Parts 400 to 699]
[Revised as of January 1, 1999](Amended September 25, 2000)
From the U.S. Government Printing Office via GPO Access
[CITE: 7CFR657.1; 7CFR657.2; 7CFR657.3; 7CFR657.4; 7CFR657.5.]

[beginning Page 699]

TITLE 7--AGRICULTURE

DEPARTMENT OF AGRICULTURE

PART 657--PRIME AND UNIQUE FARMLANDS--Table of Contents

Subpart A--Important Farmlands Inventory

Sec. 657.1 Purpose.

NRCS is concerned about any action that tends to impair the productive capacity of American agriculture. The Nation needs to know the extent and location of the best land for producing food, feed, fiber forage, and oilseed crops. In addition to prime and unique farmlands, farmlands that are of statewide and local importance for producing these crops also need to be identified.

Sec. 657.2 Policy.

It is NRCS policy to make and keep current an inventory of the prime farmland and unique farmland of the Nation. This inventory is to be carried out in cooperation with other interested agencies at the National, State, and local levels of government. The objective of the inventory is to identify the extent and location of important rural lands needed to produce food, feed, fiber, forage, and oilseed crops.

Sec. 657.3 Applicability.

Inventories made under this memorandum do not constitute a designation of any land area to a specific land use. Such designations are the responsibility of appropriate local and State officials.

Sec. 657.4 NRCS responsibilities.

(a) State Conservationist. Each NRCS State Conservationist is to:

(1) Provide leadership for inventories of important farmlands for the State, county, or other subdivision of the State. Each is to work with appropriate agencies of State government and others to establish priorities for making these inventories.

(2) Identify the soil mapping units within the State that qualify as prime. In doing this, State Conservationists, in consultation with the cooperators of the National Cooperative Soil Survey, have the flexibility to make local deviation from the permeability criterion or to be more restrictive for other specific criteria in order to assure the most accurate identification of prime farmlands for a State. Each is to invite representatives of the Governor's office, agencies of the State government, and others to identify farmlands of statewide importance and unique farmlands that are to be inventoried within the framework of this memorandum.

(3) Prepare a statewide list of:

(i) Soil mapping units that meet the criteria for prime farmland;

(ii) Soil mapping units that are farmlands of statewide importance if the criteria used were based on soil information; and

(iii) Specific high-value food and fiber crops that are grown and, when combined with other favorable factors, qualify lands to meet the criteria for unique farmlands. Copies are to be furnished to NRCS Field Offices and to National Soil Survey Center. (see 7 CFR 600.2(c), 600.6)

(4) Coordinate soil mapping units that qualify as prime farmlands with adjacent States, including Major Land Resource Area Offices (see 7 CFR 600.4, 600.7) responsible for the soil series. Since farmlands of statewide importance and unique farmlands are designated by others at the State level, the soil mapping units and areas identified need not be coordinated among States.

(5) Instruct NRCS District Conservationists to arrange local review of lands identified as prime, unique, and additional farmlands of statewide importance by Conservation Districts and representatives of local agencies. This review is to determine if additional farmland should be identified to meet local decision making needs.

(6) Make and publish each important farmland inventory on a base map of national map accuracy at an intermediate scale of 1:50,000 or 1:100,000. State Conservationists who need base maps of other scales are to submit their requests with justification to the Chief for consideration.

(b) National Soil Survey Center. The National Soil Survey Center is to provide requested technical assistance to State Conservationists and Major Land Resource Area Offices in inventorying prime and unique farmlands (see 7 CFR 600.2(c)(1), 600.4, 600.7). This includes reviewing statewide lists of soil mapping units that meet the criteria for prime farmlands and resolving coordination problems that may occur among States for specific soil series or soil mapping units.

(c) National Office. The Deputy Chief for Soil Survey and Resource Assessment (see 7 CFR 600.2(b)(3)) is to provide national leadership in preparing guidelines for inventorying prime farmlands and for national statistics and reports of prime farmlands.

Sec. 657.5 Identification of important farmlands.

(a) Prime farmlands--(1) General. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland,

rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding. Examples of soils that qualify as prime farmland are Palouse silt loam, 0 to 7 percent slopes; Brookston silty clay loam, drained; and Tama silty clay loam, 0 to 5 percent slopes.

(2) Specific criteria. Prime farmlands meet all the following criteria: Terms used in this section are defined in USDA publications: ``Soil Taxonomy, Agriculture Handbook 436''; ``Soil Survey Manual, Agriculture Handbook 18''; ``Rainfall-erosion Losses From Cropland, Agriculture Handbook 282''; ``Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346''; and ``Saline and Alkali Soils, Agriculture Handbook 60.''

(i) The soils have:

(A) Aquic, udic, ustic, or xeric moisture regimes and sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone (root zone is the part of the soil that is penetrated or can be penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; or

(B) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; or,

(C) Aridic or torric moisture regimes and the area has a developed irrigation water supply that is dependable and of adequate quality; and,

(ii) The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 32 deg. F (0 deg. C). In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47 deg. F (8 deg. C); in soils that have no O horizon, the mean summer temperature is higher than 59 deg. F (15 deg. C); and,

(iii) The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep; and,

(iv) The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and,

(v) The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15; and,

(vi) The soils are not flooded frequently during the growing season

(less often than once in 2 years); and,

(vii) The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soils erodibility) x C (climatic factor) does not exceed 60; and

(viii) The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59 deg. F (15 deg. C); the permeability rate is not a limiting factor if the mean annual soil temperature is 59 deg. F (15 deg. C) or higher; and,

(ix) Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

(b) Unique farmland--(1) General. Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops are citrus, tree nuts, olives, cranberries, fruit, and vegetables.

(2) Specific characteristics of unique farmland. (i) Is used for a specific high-value food or fiber crop; (ii) Has a moisture supply that is adequate for the specific crop; the supply is from stored moisture, precipitation, or a developed-irrigation system; (iii) Combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, aspect, or other conditions, such a nearness to market, that favor the growth of a specific food or fiber crop.

(c) Additional farmland of statewide importance. This is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate State agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. In some States, additonal farmlands of statewide importance may include tracts of land that have been designated for agriculture by State law.

(d) Additional farmland of local importance. In some local areas there is concern for certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops, even though these lands are not identified as having national or statewide importance. Where appropriate, these lands are to be identified by the local agency or agencies concerned. In places, additional farmlands of local importance may include tracts of land that have been designated for agriculture by local ordinance.

Exhibit 622-2 Land Capability Classification (Agriculture Handbook 210)

LAND-CAPABILITY CLASSIFICATION

Agriculture Handbook No. 210

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

FOREWORD

Since soil surveys are based on all of the characteristics of soils that influence their use and management, interpretations are needed for each of the many uses. Among these interpretations the grouping of soils into capability units, subclasses, and classes is one of the most important. This grouping serves as an introduction of the soil map to farmers and other land users developing conservation plans.

As we have gained experience in this grouping, the definitions of the categories have improved. It is the purpose of this publication to set forth these definitions. In using the capability classification, the reader must continually recall that it is an interpretation. Like other interpretations, it depends on the probable interactions between the kind of soil and the alternative systems of management. Our management systems are continually changing. Economic conditions change. Our knowledge grows. Land users are continually being offered new things, such as new machines, chemicals, and plant varieties.

The new technology applies unevenly to the various kinds of soil. Thus the grouping of any one kind of soil does not stay the same with changes in technology. That is, new combinations of practices increase the productivity of some soils more than others, so some are going up in the scale whereas others are going down, relatively. Some of our most productive soils of today were considered poorly suited to crops a few years ago. On the other hand, some other soils that were once regarded as good for cropping are now being used more productively for growing pulpwood. These facts in no way suggest that we should not make interpretations. In fact, they become increasingly important as technology grows. But these facts do mean that soils need to be reinterpreted and regrouped after significant changes in economic conditions and technology.

Besides the capability classification explained in this publication, other important interpretations are made of soil surveys. Examples include groupings of soils according to crop-yield predictions, woodland suitability, range potentiality, wildlife habitat, suitability for special crops, and engineering behavior. Many other kinds of special groupings are used to help meet local needs.

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LAND-CAPABILITY CLASSIFICATION

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The standard soil-survey map shows the different kinds of soil that are significant and their location in relation to other features of the landscape. These maps are intended to meet the needs of users with widely different problems and, therefore, contain considerable detail to show important basic soil differences.

The information on the soil map must be explained in a way that has meaning to the user. These explanations are called interpretations. Soil maps can be interpreted by (1) the individual kinds of soil on the map, and (2) the grouping of soils that behave similarly in responses to management and treatment. Because there are many kinds of soil, there are many individual soil interpretations. Such interpretations, however, provide the user with all the information that can be obtained from a soil map. Many users of soil maps want more general information than that of the individual soil-mapping unit. Soils are grouped in different ways according to the specific needs of the map user. The kinds of soil grouped and the variation permitted within each group differ according to the use to be made of the grouping.

The capability classification is one of a number of interpretive groupings made primarily for agricultural purposes. As with all interpretive groupings, the capability classification begins with the individual soil-mapping units, which are building stones of the system (table 1). In this classification, the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils (soils unsuitable for longtime sustained use for cultivated crops) are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risks of soil damage if mismanaged.

The individual mapping units on soil maps show the location and extent of the different kinds of soil. One can make the greatest number of precise statements and predictions about the use and management of the individual mapping units shown on the soil map. The capability grouping of soils is designed (1) to help landowners and others use and interpret the soil maps, (2) to introduce users to the detail of the soil map itself, and (3) to make possible broad generalizations based on soil potentialities, limitations in use, and management problems.

The capability classification provides three major categories of soil groupings: (1) capability unit, (2) capability subclass, and (3) capability class.

TABLE 1. Relationship of soil-mapping unit to capability classification.

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Soil-mapping unit

A soil mapping unit is a portion of the landscape that has similar characteristics and qualities and whose limits are fixed by precise definitions. Within the cartographic limitations and considering the purpose for which the map is made, the soil mapping unit is the unit about which the greatest number of precise statements and predictions can be made.

The soil mapping units provide the most detailed soils information. The basic mapping units are the basis for all interpretive groupings of soils. They furnish the information needed for developing capability units, forest site groupings, crop suitability groupings, range site groupings, engineering groupings, and other interpretive groupings. The most specific management practices and estimated yields are related to the individual mapping unit.

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Capability unit

A capability unit is a grouping of one or more individual soil mapping units having similar potentials and continuing limitations or hazards. The soils in a capability unit are sufficiently uniform to (a) produce similar kinds of cultivated crops and pasture plants with similar management practices, (b) require similar conservation treatment and management under the same kind and condition of vegetative cover, (c) have comparable potential productivity.

The capability unit condenses and simplifies soils information for planning individual tracts of land, field by field. Capability units with the class and subclass furnish information about the degree of limitation, kind of conservation problems and the management practices needed.

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Capability subclass

Subclasses are groups of capability units which have the same major conservation problem, such as:

e - Erosion and runoff
w - Excess water
s - Root-zone limitations
c - Climatic limitations

The capability subclass provides information as to the kind of conservation problem or limitations involved. The class and subclass together provide the map user information about both the degree of limitation and kind of problem involved for broad program planning, conservation need studies, and similar purposes.

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Capability class

Capability classes are groups of capability subclasses or capability units that have the same relative degree of hazard or limitation. The risks of soil damage or limitation in use become progressively greater from class I to class VIII.

The capability classes are useful as a means of introducing the map user to the more detailed information on the soil map. The classes show the location, amount, and general suitability of the soils for agricultural use. Only information concerning general agricultural limitations in soil use are obtained at the capability class level.

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The first category, capability unit, is a grouping of soils that have about the same responses to systems of management of common cultivated crops and pasture plants. Soils in any one capability unit are adapted to the same kinds of common cultivated and pasture plants and require similar alternative systems of management for these crops. Longtime estimated yields of adapted crops for individual soils within the unit under comparable management do not vary more than about 25 percent.[1]

The second category, the subclass, is a grouping of capability units having similar kinds of limitations and hazards. Four general kinds of limitations or hazards are recognized: (1) erosion hazard, (2) wetness, (3) rooting-zone limitations, and (4) climate.

The third and broadest category in the capability classification places all the soils in eight capability classes. The risks of soil damage or limitations in use become progressively greater from class I to class VIII. Soils in the first four classes under good management are capable of producing adapted plants, such as forest trees or range plants, and the common cultivated field crops[2] and pasture plants. Soils in classes V, VI, and VII are suited to the use of adapted native plants. Some soils in classes V and VI are also capable of producing specialized crops, such as certain fruits and ornamentals, and even field and vegetable crops under highly intensive management involving elaborate practices for soil and water conservation.[3] Soils in class VIII do not return on-site benefits for inputs of management for crops, grasses, or trees without major reclamation.

The grouping of soils into capability units, subclasses, and classes is done primarily on the basis of their capability to produce common cultivated crops and pasture plants without deterioration over a long period of time. To express suitability of the soils for range and woodland use, the soil-mapping units are grouped into range sites and woodland-suitability groups.

ASSUMPTIONS

In assigning soils to the various capability groupings a number of assumptions are made. Some understanding of these assumptions is necessary if the soils are to be grouped consistently in the capability classification and if the groupings are to be used properly. They are:

[1] Yields are significant at the capability-unit level and are one of the criteria used in establishing capability units within a capability class. Normally, yields are estimated under the common management that maintains the soil resource. The main periods for such yield estimates are 10 or more years in humid areas or under irrigation and 20 or more years in subhumid or semiarid areas. The 25 percent allowable range is for economically feasible yields of adapted cultivated and pasture crops.

[2] As used here the common crops include: corn, cotton, tobacco, wheat, tame hay and pasture, oats, barley, grain sorghum, sugarcane, sugar beets, peanuts, soybeans, field-grown vegetables, potatoes, sweet potatoes, field peas and beans, flax, and most clean-cultivated fruit, nut, and ornamental plants. They do not include: rice, cranberries, blueberries, and those fruit, nut, and ornamental plants that require little or no cultivation.

[3] Soil and water conservation practices is a general expression for all practices including but not limited to those for erosion control.

1. A taxonomic (or natural) soil classification is based directly on soil characteristics. The capability classification (unit, subclass, and class) is an interpretive classification based on the effects of combinations of climate and permanent soil characteristics on risks of soil damage, limitations in use, productive capacity, type of clay minerals, and the many other similar features are considered permanent soil qualities and characteristics. Shrubs, trees, or stumps are not considered permanent characteristics.

2. The soils within a capability class are similar only with respect to degree of limitations in soil use for agricultural purposes or hazard to the soil when it is so used. Each class includes many different kinds of soil, and many of the soils within any one class require unlike management and treatment. Valid generalizations about suitable kinds of crops or other management needs cannot be made at the class level.

3. A favorable ratio of output to input[4] is one of several criteria used for placing any soil in a class suitable for cultivated crop, grazing, or woodland use, but no further relation is assumed or implied between classes and output-input ratios. The capability classification is not a productivity rating for specific crops. Yield estimates are developed for specific kinds of soils and are included in soil handbooks and soil-survey reports.

4. A moderately high level of management is assumed -- one that is practical and within the ability of a majority of the farmers and ranchers. The level of management is that commonly used by the "reasonable" men of the community. The capability classification is not, however, a grouping of soils according to the most profitable use to be made of the land. For example, many soils in class III or IV, defined as suitable for several uses including cultivation, may be more profitably used for grasses or trees than for cultivated crops.

5. Capability classes I through IV are distinguished from each other by a summation of the degree of limitations or risks of soil damage that affect their management requirements for longtime sustained use for cultivated crops. Nevertheless, differences in kinds of management or yields of perennial vegetation may be greater between some pairs of soils within one class than between some pairs of soils from different classes. The capability class is not determined by the kind of practices recommended. For example, class II, III, or IV may or may not require the same kind of practices when used for cultivated crops, and classes I through VII may or may not require the same kind of pasture, range, or woodland practices.

[4] Based on longtime economic trends for average farms and farmers using moderately high level management. May not apply to specific farms and farmers but will apply to broad areas.

6. Presence of water on the surface or excess water in the soil; lack of water for adequate crop production; presence of stones; presence of soluble salts or exchangeable sodium, or both; or hazard of overflow are not considered permanent limitations to use where the removal of these limitations is feasible.[5]

7. Soils considered feasible for improvement by draining, by irrigating, by removing stones, by removing salts or exchangeable sodium, or by protecting from overflow are classified according to their continuing limitations in use, or the risks of soil damage, or both, after the improvements have been installed. Differences in initial costs of the systems installed on individual tracts of land do not influence the classification. The fact that certain wet soils are in classes II, III, and IV does not imply that they should be drained. But it does indicate the degree of their continuing limitation in use or risk of soil damage, or both, if adequately drained. Where it is considered not feasible to improve soils by drainage, irrigation, stone removal, removal of excess salts or exchangeable sodium, or both, or to protect them from overflow, they are classified according to present limitations in use.

8. Soils already drained or irrigated are grouped according to the continuing soil and climatic limitations and risks that affect their use under the present systems or feasible improvements in them.

9. The capability classification of the soils in an area may be changed when major reclamation projects are installed that permanently change the limitations in use or reduce the hazards or risks of soil or crop damage for long periods of time. Examples include establishing major drainage facilities, building levees or flood-retarding structures, providing water for irrigation, removing stones, or large-scale grading of gullied land. (Minor dams, terraces, or field conservation measures subject to change in their effectiveness in a short time are not included.)

10. Capability groupings are subject to change as new information about the behavior and responses of the soils becomes available.

11. Distance to market, kinds of roads, size and shape of the soil areas, locations within fields, skill or resources of individual operators, and other characteristics of land-ownership patterns are not criteria for capability groupings.

12. Soils with such physical limitations that common field crops can be cultivated and harvested only by hand are not placed in classes I, II, III, and IV. Some of these soils need drainage or stone removal, or both, before some kinds of machinery can be used. This does not imply that mechanical equipment cannot be used on some soils in capability classes V, VI, and VII.

[5] Feasible as used in this context means (1) that the characteristics and qualities of the soil are such that it is possible to remove the limitation, and (2) that over broad areas it is within the realm of present-day economic possibility to remove the limitation.

13. Soils suited to cultivation are also suited to other uses such as pasture, range, forest, and wildlife. Some not suited to cultivation are suited to pasture, range, forest, or wildlife; others are suited only to pasture or range and wildlife; others only to forest and wildlife; and a few suited only to wildlife, recreation, and water-yielding uses. Groupings of soils for pasture, range, wildlife, or woodland may include soils from more than one capability class. Thus, to interpret soils for these uses, a grouping different from the capability classification is often necessary.

14. Research data, recorded observations, and experience are used as the bases for placing soils in capability units, subclasses, and classes. In areas where data on response of soils to management are lacking, soils are placed in capability groups by interpretation of soil characteristics and qualities in accord with the general principles about use and managemcnt developed for similar soils elsewhere.

CAPABILITY CLASSES

Land Suited to Cultivation and Other Uses

Class I – Soils in class I have few limitations that restrict their use.

Soils in this class are suited to a wide range of plants and may be used safely for cultivated crops, pasture, range, woodland, and wildlife. The soils are nearly level[6] and erosion hazard (wind or water) is low. They are deep, generally well drained, and easily worked. They hold water well and are either fairly well supplied with plant nutrients or highly responsive to inputs of fertilizer.

The soils in class I are not subject to damaging overflow. They are productive and suited to intensive cropping. The local climate must be favorable for growing many of the common field crops.

In irrigated areas, soils may be placed in class I if the limitation of the arid climate has been removed by relatively permanent irrigation works. Such irrigated soils (or soils potentially useful under irrigation) are nearly level, have deep rooting zones, have favorable permeability and water-holding capacity, and are easily maintained in good tilth. Some of the soils may require initial conditioning including leveling to the desired grade, leaching of a slight accumulation of soluble salts, or lowering of the seasonal water table. Where limitations due to salts, water table, overflow, or erosion are likely to recur, the soils are regarded as subject to permanent natural limitations and are not included in class I.

[6] Some rapidly permeable soils in class I may have gentle slopes.

Soils that are wet and have slowly permeable subsoils are not placed in class I. Some kinds of soil in class I may be drained as an improvement measure for increased production and ease of operation.

Soils in class I that are used for crops need ordinary management practices to maintain productivity -- both soil fertility and soil structure. Such practices may include the use of one or more of the following: fertilizers and lime, cover and green-manure crops, conservation of crop residues and animal manures, and sequences of adapted crops.

Class II -- Soils in class II have some limitations that reduce the choice of plants or require moderate conservation practices.

Soils in class II require careful soil management, including conservation practices, to prevent deterioration or to improve air and water relations when the soils are cultivated. The limitations are few and the practices are easy to apply. The soils may be used for cultivated crops, pasture, range, woodland, or wildlife food and cover.

Limitations of soils in class II may include singly or in combination the effects of (1) gentle slopes, (2) moderate susceptibility to wind or water erosion or moderate adverse effects of past erosion, (3) less than ideal soil depth, (4) somewhat unfavorable soil structure and workability, (5) slight to moderate salinity or sodium easily corrected but likely to recur, (6) occasional damaging overflow, (7) wetness correctable by drainage but existing permanently as a moderate limitation, and (8) slight climatic limitations on soil use and management.

The soils in this class provide the farm operator less latitude in the choice of either crops or management practices than soils in class I. They may also require special soil-conserving cropping systems, soil conservation practices, water-control devices, or tillage methods when used for cultivated crops. For example, deep soils of this class with gentle slopes subject to moderate erosion when cultivated may need one of the following practices or some combination of two or more: terracing, stripcropping, contour tillage, crop rotations that include grasses and legumes, vegetated water disposal areas, cover or green-manure crops, stubble mulching, fertilizers, manure, and lime. The exact combinations of practices vary from place to place, depending on the characteristics of the soil, the local climate, and the farming system.

Class III -- Soils in class III have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Soils in class III have more restrictions than those in class II and, when used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. They may be used for cultivated crops, pasture, woodland, range, or wildlife food and cover.

Limitations of soils in class III restrict the amount of clean cultivation; timing of planting, tillage, and harvesting; choice of crops; or some combination of these limitations. The limitations may result from the effects of one or more of the following: (1) moderately steep slopes; (2) high susceptibility to water or wind erosion or severe adverse effects of past erosion; (3) frequent overflow accompanied by some crop damage; (4) very slow permeability of the subsoil; (5) wetness or some continuing waterlogging after drainage; (6) shallow depths to bedrock, hardpan, fragipan, or claypan that limit the rooting zone and the water storage; (7) low moisture-holding capacity; (8) low fertility not easily corrected; (9) moderate salinity or sodium; or (10) moderate climatic limitations.

When cultivated, many of the wet, slowly permeable but nearly level soils in class III require drainage and a cropping system that maintains or improves the structure and tilth of the soil. To prevent puddling and to improve permeability, it is commonly necessary to supply organic material to such soils and to avoid working them when they are wet. In some irrigated areas, part of the soils in class III have limited use because of high water table, slow permeability, and the hazard of salt or sodic accumulation. Each distinctive kind of soil in class III has one or more alternative combination of use and practices required for safe use, but the number of practical alternatives for average farmers is less than that for soils in class II.

Class IV -- Soils in class IV have very severe limitations that restrict the choice of plants, require very careful management, or both.

The restrictions in use for soils in class IV are greater than those in class III and the choice of plants is more limited. When these soils are cultivated, more careful management is required and conservation practices are more difficult to apply and maintain. Soils in class IV may be used for crops, pasture, woodland, range, or wildlife food and cover.

Soils in class IV may be well suited to only two or three of the common crops or the harvest produced may be low in relation to inputs over a long period of time. Use for cultivated crops is limited as a result of the effects of one or more permanent features such as (1) steep slopes, (2) severe susceptibility to water or wind erosion, (3) severe effects of past erosion, (4) shallow soils, (5) low moisture-holding capacity, (6) frequent overflows accompanied by severe crop damage, (7) excessive wetness with continuing hazard of waterlogging after drainage, (8) severe salinity or sodium, or (9) moderately adverse climate.

Many sloping soils in class IV in humid areas are suited to occasional but not regular cultivation. Some of the poorly drained, nearly level soils placed in class IV are not subject to erosion but are poorly suited to inter-tilled crops because of the time required for the soil to dry out in the spring and because of low productivity for cultivated crops. Some soils in class IV are well suited to one or more of the special crops, such as fruits and ornamental trees and shrubs, but this suitability itself is not sufficient to place a soil in class IV.

In subhumid and semiarid areas, soils in class IV may produce good yields of adapted cultivated crops during years of above average rainfall; low yields during years of average rainfall; and failures during years of below average rainfall. During the low rainfall years the soil must be protected even though there can be little or no expectancy of a marketable crop. Special treatments and practices to prevent soil blowing, conserve moisture, and maintain soil productivity are required. Sometimes crops must be planted or emergency tillage used for the primary purpose of maintaining the soil during years of low rainfall. These treatments must be applied more frequently or more intensively than on soils in class III.

Land Limited in Use -- Generally Not Suited to Cultivation[7]

Class V -- Soils in class V have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Soils in class V have limitations that restrict the kind of plants that can be grown and that prevent normal tillage of cultivated crops. They are nearly level but some are wet, are frequently overflowed by streams, are stony, have climatic limitations, or have some combination of these limitations. Examples of class V are: (1) soils of the bottom lands subject to frequent overflow that prevents the normal production of cultivated crops, (2) nearly level soils with a growing season that prevents the normal production of cultivated crops, (3) level or nearly level stony or rocky soils, and (4) ponded areas where drainage for cultivated crops is not feasible but where soils are suitable for grasses or trees. Because of these limitations, cultivation of the common crops is not feasible but pastures can be improved and benefits from proper management can be expected.

Class VI -- Soils in class VI have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Physical conditions of soils placed in class VI are such that it is practical to apply range or pasture improvements, if needed, such as seeding, liming, fertilizing, and water control with contour furrows, drainage ditches, diversions, or water spreaders. Soils in class VI have continuing limitations that cannot be corrected, such as (1) steep slope, (2) severe erosion hazard, (3) effects of past erosion, (4) stoniness, (5) shallow rooting zone, (6) excessive wetness or overflow, (7) low moisture capacity, (8) salinity or sodium, or (9) severe climate. Because of one or more of these limitations, these soils are not generally suited to cultivated

[7] Certain soils grouped into classes V, VI, VII, and VIII may be made fit for use for crops with major earthmoving or other costly reclamation.

crops. But they may be used for pasture, range, woodland, or wildlife cover or for some combination of these.

Some soils in class VI can be safely used for the common crops provided unusually intensive management is used. Some of the soils in this class are also adapted to special crops such as sodded orchards, blueberries, or the like, requiring soil conditions unlike those demanded by the common crops. Depending upon soil features and local climate, the soils may be well or poorly suited to woodlands.

Class VII -- Soils in class VII have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Physical conditions of soils in class VII are such that it is impractical to apply such pasture or range improvements as seeding, liming, fertilizing, and water control with contour furrows, ditches, diversions, or water spreaders. Soil restrictions are more severe than those in class VI because of one or more continuing limitations that cannot be corrected, such as (1) very steep slopes, (2) erosion, (3) shallow soil, (4) stones, (5) wet soil, (6) salts or sodium, (7) unfavorable climate, or (8) other limitations that make them unsuited to common cultivated crops. They can be used safely for grazing or woodland or wildlife food and cover or for some combination of these under proper management.

Depending upon the soil characteristics and local climate, soils in this class may be well or poorly suited to woodland. They are not suited to any of the common cultivated crops; in unusual instances, some soils in this class may be used for special crops under unusual management practices. Some areas of class VII may need seeding or planting to protect the soil and to prevent damage to adjoining areas.

Class VIII --- Soils and landforms in class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.

Soils and landforms in class VIII cannot be expected to return significant on-site benefits from management for crops, grasses, or trees, although benefits from wildlife use, watershed protection, or recreation may be possible.

Limitations that cannot be corrected may result from the effects of one or more of the following: (1) erosion or erosion hazard, (2) severe climate, (3) wet soil, (4) stones, (5) low moisture capacity, and (6) salinity or sodium.

Badlands, rock outcrop, sandy beaches, river wash, mine tailings, and other nearly barren lands are included in class VIII. It may be necessary to give protection and management for plant growth to soils and landforms in class VIII in order to protect other more valuable soils, to control water, or for wildlife or esthetic reasons.

CAPABILITY SUBCLASSES

Subclasses are groups of capability units within classes that have the same kinds of dominant limitations for agricultural use as a result of soil and climate. Some soils are subject to erosion if they are not protected, while others are naturally wet and must be drained if crops are to be grown. Some soils are shallow or droughty or have other soil deficiencies. Still other soils occur in areas where climate limits their use. The four kinds of limitations recognized at the subclass level are: risks of erosion, designated by the symbol (e); wetness, drainage, or overflow (w); rooting-zone limitations (s); and climatic limitations (c). The subclass provides the map user information about both the degree and kind of limitation. Capability class I has no subclasses.

Subclass **(e) erosion** is made up of soils where the susceptibility to erosion is the dominant problem or hazard in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.

Subclass **(w) excess water** is made up of soils where excess water is the dominant hazard or limitation in their use. Poor soil drainage, wetness, high water table, and overflow are the criteria for determining which soils belong in this subclass.

Subclass **(s) soil limitations within the rooting zone** includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, and salinity or sodium.

Subclass **(c) climatic limitation** is made up of soils where the climate (temperature or lack of moisture) is the only major hazard or limitation in their use.[8]

Limitations imposed by erosion, excess water, shallow soils, stones, low moisture-holding capacity, salinity, or sodium can be modified or partially overcome and take precedence over climate in determining subclasses. The dominant kind of limitation or hazard to the use of the land determines the assignment of capability units to the (e), (w), and (s) subclasses. Capability units that have no limitation other than climate are assigned to the (c) subclass.

Where two kinds of limitations that can be modified or corrected are essentially equal, the subclasses have the following priority: e, w, s. For example, we need to group a few soils of humid areas that have both an erosion hazard and an excess water hazard; with them the e

[8] Especially among young soils such as alluvial soils, although not limited to them, climatic phases of soil series must be established for proper grouping into capability units and into other interpretive groupings. Since the effects result from interactions between soil and climate, such climatic phases are not defined the same in terms of precipitation, temperature, and so on, for contrasting kinds of soil.

takes precedence over the w. In grouping soils having both an excess water limitation and a rooting-zone limitation, the w takes precedence over the s. In grouping soils of subhumid and semiarid areas that have both an erosion hazard and a climatic limitation, the e takes precedence over the c; and in grouping soils with both rooting-zone limitations and climatic limitations, the s takes precedence over the c.

Where soils have two kinds of limitations, both can be indicated, if needed, for local use; the dominant one is shown first. Where two kinds of problems are shown for a soil group, the dominant one is used for summarizing data by subclasses.

CAPABILITY UNITS

The capability units provide more specific and detailed information than the subclass for application to specific fields on a farm or ranch. A capability unit is a grouping of soils that are nearly alike in suitability for plant growth and responses to the same kinds of soil management. That is, a reasonably uniform set of alternatives can be presented for the soil, water, and plant management of the soils in a capability unit, not considering effects of past management that do not have a more or less permanent effect on the soil. Where soils have been so changed by management that permanent characteristics have been altered, they are placed in different soil series. Soils grouped into capability units respond in a similar way and require similar management although they may have soil characteristics that put them in different soil series.

Soils grouped into a capability unit should be sufficiently uniform in the combinations of soil characteristics that influence their qualities to have similar potentialities and continuing limitations or hazards. Thus the soils in a capability unit should be sufficiently uniform to (a) produce similar kinds of cultivated crops and pasture plants with similar management practices, (b) require similar conservation treatment and management under the same kind and condition of vegetative cover, and (c) have comparable potential productivity. (Estimated average yields under similar management systems should not vary more than about 25 percent among the kinds of soil included within the unit.)

OTHER KINDS OF SOIL GROUPINGS

Other kinds of interpretive soil groupings are necessary to meet specific needs. Among these are groupings for range use, woodland use, special crops, and engineering interpretation.

The range site is a grouping of soils with a potential for producing the same kinds and amounts of native forage. The range site for rangeland is comparable to the capability unit for cultivated land. The purpose of such a grouping is to show the potential for range use and to provide the basis for which the criteria for determining range condition can be established. The soils grouped into a single range site may be expected to produce similar longtime yields and respond similarly to alternative systems of management and to such practices as seeding, pitting, and water spreading.

Soils suitable for range but not for common cultivated crops may be placed in capability classes V and VI if they are capable of returning inputs from such management practices as seeding, fertilizing, or irrigating; and in class VII if they are not. If these soils do not give economic returns under any kind of management when used for cultivated crops, pasture, woodland or range, they fall in class VIII.

Soil-woodland site index correlations are essential for interpreting the potential wood production of the individual soil units that are mapped. Woodland-site indices are commonly developed for individual kinds of soils. Soil-mapping units can be placed in woodland groupings according to site indices for adapted species and other responses and limitations significant to woodland conservation. Such groupings do not necessarily parallel those for capability units or range sites; however, in some areas capability units may be grouped into range sites and woodland-suitability groups.

Rice has soil requirements unlike those of the common cultivated crops requiring well-aerated soils. Some fruits and ornamentals do not require clean cultivation. Therefore, these crops are not given weight in the capability grouping. Instead, special groupings of the soils for each of these crops are made in the areas where they are significant.

With a good basic table of yields and practices, the soils can be placed in any number of suitability groups. Commonly, five groups -- unsuited, fairly suited, moderately suited, well suited, and very well suited -- are sufficient.

Kinds of soil shown on the soil map are also grouped according to need for applying engineering measures including drainage, irrigation, land leveling, land grading; determining suitability as subgrade for roads; and constructing ponds and small dams. Such groupings may be unlike those made for other purposes.

CRITERIA FOR PLACING SOILS IN CAPABILITY CLASSES

Soil and climatic limitations in relation to the use, management, and productivity of soils are the bases for differentiating capability classes. Classes are based on both degree and number of limitations affecting kind of use, risks of soil damage if mismanaged, needs for soil management, and risks of crop failure. To assist in making capability groupings, specific criteria for placing soils in units, subclasses, and classes are presented here. Because the effects of soil characteristics and qualities vary widely with climate, these criteria must be for broad soil areas that have similar climate.

Capability groupings are based on specific information when available information about the responses of the individual kinds of soil to management and the combined effect of climate and soil on the crops grown. It comes from research findings, field trials, and experiences of farmers and other agricultural workers. Among the more common kinds of information obtained are soil and water losses, kinds and amounts of plants that can be grown, weather conditions as they affect plants, and the effect of different kinds and levels of management on plant response. This information is studied along with laboratory data on soil profiles. Careful analysis of this information proves useful not only in determining the capability of these individual kinds of soil but also in making predictions about the use and management of related kinds of soil.

Basic yield estimates of the adapted crops under alternative, defined systems of management are assembled in a table. Where data are few, the estimates should be reasonable when tested against available farm records and studies of the combinations of soil properties.

Where information on response of soils to management is lacking, the estimates of yields and the grouping of soils into capability units, subclasses, and classes are based on an evaluation of combinations of the following:

1. Ability of the soil to give plant response to use and management as evidenced by organic-matter content, ease of maintaining a supply of plant nutrients, percentage base saturation, cation-exchange capacity, kind of clay mineral, kind of parent material, available water holding capacity, response to added plant nutrients, or other soil characteristics and qualities.

2. Texture and structure of the soil to the depth that influences the environment of roots and the movement of air and water.

3. Susceptibility to erosion as influenced by kind of soil (and slope) and the effect of erosion on use and management.

4. Continuous or periodic waterlogging in the soil caused by slow permeability of the underlying material, a high water table, or flooding.

5. Depth of soil material to layers inhibiting root penetration.

6. Salts toxic to plant growth.

7. Physical obstacles such as rocks, deep gullies, etc.

8. Climate (temperature and effective moisture).

This list is not intended to be complete. Although the soils of any area may differ from one another in only a few dozen characteristics, none can be taken for granted. Extreme deficiencies or excesses of trace elements, for example, can be vital. Commonly, the underlying geological strata are significant to water infiltration, water yield, and erosion hazard.

Any unfavorable fixed or recurring soil or landscape features may limit the safe and productive use of the soil. One unfavorable feature in the soil may so limit its use that extensive treatment would be required. Several minor unfavorable features collectively may become a major problem and thus limit the use of the soil. The combined effect of these in relation to the use, management, and productivity of soils is the criterion for different capability units.

Some of the criteria used to differentiate between capability classes are discussed on the following pages. The criteria and ranges in characteristics suggested assume that the effects of other soil characteristics and qualities are favorable and are not limiting factors in placing soils in capability classes.

Arid and Semiarid, Stony, Wet, Saline-Sodic, and Overflow Soils

The capability-class designations assigned to soils subject to flooding, poorly or imperfectly drained soils, stony soils, dry soils needing supplemental water, and soils having excess soluble salts or exchangeable sodium are made on the basis of continuing limitations and hazards after removal of excess water, stones, salts, and exchangeable sodium.

When assessing the capability class of any soil the feasibility of any necessary land improvements must be considered. Feasible as used here means (1) that the characteristics and qualities of the soil are such that it is possible to remove the limitation, and (2) that over broad areas it is within the realm of economic possibility to remove the limitation. The capability designation of these areas is determined by those practices that are practical now and in the immediate future.

The following kinds of soil are classified on the basis of their present continuing limitations and hazards: (1) dry soils (arid and semiarid areas) now irrigated, (2) soils from which stones have been removed, (3) wet soils that have been drained, (4) soils from which excess quantities of soluble salts or exchangeable sodium have been removed, and (5) soils that have been protected from overflow.

The following kinds of soil are classified on the basis of their continuing limitations and hazards as if the correctable limitations had been removed or reduced: (1) dry soils not now irrigated but for which irrigation is feasible and water is available, (2) stony soils for which stone removal is feasible, (3) wet soils not now drained but for which drainage is feasible, (4) soils that contain excess quantities of soluble salts or exchangeable sodium feasible to remove, and (5) soils subject to overflow but for which protection from overflow is feasible. Where desirable or helpful, the present limitation due to wetness, stoniness, etc., may be indicated.

The following kinds of soil are classified on the basis of their present continuing limitations and hazards if the limitations cannot feasibly be corrected or removed: (1) dry soils, (2) stony soils, (3) soils with excess quantities of saline and sodic salts, (4) wet soils, or (5) soils subject to overflow.

Climatic Limitations

Climatic limitations (temperature and moisture) affect capability. Extremely low temperatures and short growing seasons are limitations, especially in the very northern part of continental United States and at high altitudes.

Limited natural moisture supply affects capability in subhumid, semiarid, and arid climates. As the classification in any locality is derived in part from observed performance of crop plants, the effects of the interaction of climate with soil characteristics must be considered. In a subhumid climate, for example, certain sandy soils may be classified as class VI or class VII, whereas soils with similar water-holding capacity in a more humid climate are classified as class III or IV. The moisture factor must be directly considered in the classification in most semiarid and arid climates. The capability of comparable soils decreases as effective rainfall decreases.

In an arid climate, the moisture from rain and snow is not enough to support crops. Arid land can be classed as suited to cultivation (class I, II, III, or IV) only if the moisture limitation is removed by irrigation. Wherever the moisture limitation is removed in this way, the soil is classified according to the effects of other permanent features and hazards that limit its use and permanence, without losing sight of the practical requirements of irrigation farming.

Wetness Limitations

Water on the soil or excess water in the soil presents a hazard to or limits its use. Such water may be a result of poor soil drainage, high water table, overflow (includes stream overflow, ponding, and runoff water from higher areas), and seepage. Usually soil needing drainage has some permanent limitation that precludes placing it in class I even after drainage.

Wet soils are classified according to their continuing soil limitations and hazards after drainage. In determining the capability of wet areas, emphasis is placed on practices considered practical now or in the foreseeable future. The vast areas of marshland along the seacoast or high-cost reclamation projects not now being planned or constructed are not classified as class I, II, or III. If reclamation projects are investigated and found to be feasible, the soils of the area are reclassified based on the continuing limitations and hazards after drainage. This places the classification of wet soils on a basis similar to that of the classification of irrigated, stony, saline, or overflow soils. Some large areas of bottomland subject to overflow are reclassified when protected by dikes or other major reclamation work. There are examples of these along streams where levees have been constructed. Land already drained is classified according to the continuing limitations and hazards that affect its use.

Needs for initial conditioning, such as for clearing of trees or swamp vegetation, are not considered in the capability classification. They may be of great importance, however, in making some of the land-management decisions. Costs of drainage, likewise, are not considered directly in the capability classification, although they are important to the land manager.

Toxic Salts

Presence of soluble salts or exchangeable sodium in amounts toxic to most plants can be a serious limiting factor in land use. Where toxic salts are the limiting factor, the following ranges are general guides until more specific criteria are available:

- Class II -- Crops slightly affected. In irrigated areas, even after salt removal, slight salinity or small amounts of sodium remains or is likely to recur.
- Class III -- Crops moderately affected. In irrigated areas, even after salt removal, moderate salinity or moderate amounts of sodium remains or is likely to recur.
- Classes IV-VI -- Crops seriously affected on cultivated land. Usually only salt-tolerant plants will grow on noncultivated land. In irrigated areas, even after leaching, severe salinity or large amounts of sodium remains or is likely to recur.

- Class VII -- Satisfactory growth of useful vegetation impossible, except possibly for some of the most salt-tolerant forms, such as some Atriplexes that have limited use for grazing.

Slope and Hazard of Erosion

Soil damage from erosion is significant in the use, management, and response of soil for the following reasons:

1. An adequate soil depth must be maintained for moderate to high crop production. Soil depth is critical on shallow soils over nonrenewable substrata such as hard rock. These soils tolerate less damage from erosion than soils of similar depth with a renewable substrata such as the raw loess or soft shale that can be improved through the use of special tillage, fertilizer, and beneficial cropping practices.

2. Soil loss influences crop yields. The reduction in yield following the loss of each inch of surface soil varies widely for different kinds of soil. The reduction is least on soils having little difference in texture, consistence, and fertility between the various horizons of the soil. It is greatest where there is a marked difference between surface layers and subsoils, such as among soils with claypans. For example, corn yields on soils with dense, very slowly permeable subsoils may be reduced 3 to 4 bushels per acre per year for each inch of surface soil lost. Yield reduction is normally small on deep, moderately permeable soils having similar textured surface and subsurface layers and no great accumulation of organic matter in the surface soil.

3. Nutrient loss through erosion on sloping soils is important not only because of its influence on crop yield but also because of cost of replacement to maintain crop yields. The loss of plant nutrients can be high, even with slight erosion.

4. Loss of surface soil changes the physical condition of the plow layer in soils having finer textured layers below the surface soil. Infiltration rate is reduced; erosion and runoff rates are increased; tilth is difficult to maintain; and tillage operations and seedbed preparation are more difficult.

5. Loss of surface soil by water erosion, soil blowing, or land leveling may expose highly calcareous lower strata that are difficult to make into suitable surface soil.

6. Water-control structures are damaged by sediments due to erosion. Maintenance of open drains and ponds becomes a problem and their capacity is reduced as sediment accumulates.

7. Gullies form as a result of soil loss. This kind of soil damage causes reduced yields, increased sediment damage, and physical difficulties in farming between the gullies.

The steepness of slope, length of slope, and shape of slope (convex or concave) all directly influence the soil and water losses from a field. Steepness of slope is recorded on soil maps. Length and shape of slopes are not recorded on soil maps; however, they are often characteristic of certain kinds of soil, and their effects on use and management can be evaluated as a part of the mapping unit.

Where available, research data on tons of soil loss per acre per year under given levels of management are used on sloping soils to differentiate between capability classes.

Soil Depth

Effective depth includes the total depth of the soil profile favorable for root development. In some soils, this includes the C horizon; in a few only the A horizon is included. Where the effect of depth is the limiting factor, the following ranges are commonly used: class I, 36 inches or more; class II, 20-36 inches; class III, 10-20 inches; and class IV, less than 10 inches. These ranges in soil depth between classes vary from one section of the country to another depending on the climate. In arid and semiarid areas, irrigated soils in class I are 60 or more inches in depth. Where other unfavorable factors occur in combination with depth, the capability decreases.

Previous Erosion

On some kinds of soil previous erosion reduces crop yields and the choice of crops materially; on others the effect is not great. The effect of past erosion limits the use of soils (1) where subsoil characteristics are unfavorable, or (2) where soil material favorable for plant growth is shallow to bedrock or material similar to bedrock, in some soils, therefore, the degree of erosion influences the capability grouping.

Available Moisture-Holding Capacity

Water-holding capacity is an important quality of soil. Soils that have limited moisture-holding capacity are likely to be droughty and have limitations in kinds and amounts of crops that can be grown; they also present fertility and other management problems. The ranges in water-holding capacity for the soils in the capability classes vary to a limited degree with the amount and distribution of effective precipitation during the growing season. Within a capability class, the range in available moisture-holding capacity varies from one climatic region to another.

GLOSSARY

Alluvial soils -- Soils developing from transported and relatively recently deposited material (alluvium) with little or no modification of the original materials by soil-forming processes. (Soils with well-developed profiles that have formed from alluvium are grouped with other soils having the same kind of profiles, not with the alluvial soils.)

Available nutrient in soils -- The part of the supply of a plant nutrient in the soil that can be taken up by plants at rates and in amounts significant to plant growth.

Available water in soils -- The part of the water in the soil that can be taken up by plants at rates significant to their growth; usable; obtainable.

Base saturation -- The relative degree to which soils have metallic cations absorbed. The proportion of the cation-exchange capacity that is saturated with metallic cations.

Cation-exchange capacity -- A measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7) or at some other stated pH value. (Formerly called base-exchange capacity.)

Clay mineral -- Naturally occurring inorganic crystalline material in soils or other earthy deposits of clay size-particles less than 0.002 mm in diameter.

Deep soil -- Generally, a soil deeper than 40 inches to rock or other strongly contrasting material. Also, a soil with a deep black surface layer; a soil deeper than about 40 inches to the parent material or to other unconsolidated rock material not modified by soil-forming processes; or a soil in which the total depth of unconsolidated material, whether true soil or not, is 40 inches or more.

Drainage, soil -- (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation. For example, in well-drained soils, the water is removed readily, but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods and the roots of ordinary crop plants cannot get enough oxygen; and in excessively drained soils, the water is removed so completely that most crop plants suffer from lack of water.

Drought -- A period of dryness, especially a long one. Usually considered to be any period of soil-moisture deficiency within the plant root zone. A period of dryness of sufficient length to deplete soil moisture to the extent that plant growth is seriously retarded.

Erosion -- The wearing away of the land surface by detachment and transport of soil and rock materials through the action of moving water, wind, or other geological agents.

Fertility, soil -- The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field capacity -- The amount of moisture remaining in a soil after the free water has been allowed to drain away into drier soil material beneath; usually expressed as a percentage of the ovendry weight of soil or other convenient unit. It is the highest amount of moisture that the soil will hold tinder conditions of free drainage after excess water has drained away following a rain or irrigation that has wet the whole soil. For permeable soils of medium texture, this is about 2 or 3 days after a rain or thorough irrigation. Although generally similar for one kind of soil, values vary with previous treatments of the soil.

First bottom -- The normal flood plain of a stream, subject to frequent or occasional flooding.

Parent material -- The unconsolidated mass of rock material (or peat) from which the soil profile develops.

Permeability, soil -- The quality of a soil horizon that enables water or air to move through it. It can be measured quantitatively in terms of rate of flow of water through a unit cross section in unit time under specified temperature and hydraulic conditions. Values for saturated soils usually are called hydraulic conductivity. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

Phase, soil -- The subdivision of a soil type or other classificational soil unit having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of soil types include differences in slope, stoniness, and thickness because of accelerated erosion.

Profile (soil) -- A vertical section of the soil through all its horizons and extending into the parent material.

Range (or rangeland) -- Land that produces primarily native forage plants suitable for grazing by livestock, including land that has some forest trees.

Runoff -- The surface flow of water from an area; or the total volume of surface flow during a specified time.

Saline soil -- A soil containing enough soluble salts to impair its productivity for plants but not containing an excess of exchangeable sodium.

Series, soil -- A group of soils that have soil horizons similar in their differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and are formed from a particular type of parent material. Soil series is an important category in detailed soil classification. Individual series are given proper names from place names near the first recorded occurrence. Thus names like Houston, Cecil, Barnes, and Miami are names of soil series that appear on soil maps and each connotes a unique combination of many soil characteristics.

Sodic soil (alkali) -- Soil that contains sufficient sodium to interfere with the growth of most crop plants; soils for which the exchangeable-sodium-percentage is 15 or more.

Soil -- (1) The natural medium for the growth of land plants. (2) A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. (3) The collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

A soil is an individual three-dimensional body on the surface of the earth unlike the adjoining bodies. (The area of individual soils ranges from less than 1/2 acre to more than 300 acres.)

A kind of soil is the collection of soils that are alike in specified combinations of characteristics. Kinds of soil are given names in the system of soil classification. The terms "the soil" and "soil" are collective terms used for all soils, equivalent to the word "vegetation" for all plants.

Soil characteristic -- A feature of a soil that can be seen and/or measured in the field or in the laboratory on soil samples. Examples include soil slope and stoniness as well as the texture, structure, color, and chemical composition of soil horizons.

Soil management -- The preparation, manipulation, and treatment of soils for the production of plants, including crops, grasses, and trees.

Soil quality -- An attribute of a soil that cannot be seen or measured directly from the soil alone but which is inferred from soil characteristics and soil behavior under defined conditions. Fertility, productivity, and erodibility are examples of soil qualities (in contrast to soil characteristics).

Soil survey -- A general term for the systematic examination of soils in the field and in the laboratories, their description and classification, the mapping of kinds of soil, and the interpretation of soils according to their adaptability for various crops, grasses, and trees, their behavior under use or treatment for plant production or for other purposes, and their productivity under different nianagernew systems.

Structure, soil -- The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are platy, prismatic, columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain -- each grain by itself, as in dune sand; or (2) massive -- the particles adhering together without any regular cleavage as in many claypans and hardpans. ("Good" or "bad" tilth are terms for the general structural condition of cultivated soils according to particular plants or sequences of plants.)

Subsoil -- The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."

Surface soil -- The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness.

Texture, soil -- The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, it refers to the proportions of sand, silt, and clay.

Type, soil -- A subgroup or category under the soil series based on the texture of the surface soil. A soil type is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. The name of a soil type consists of the name of the soil series plus the textural class name of the upper part of the soil equivalent to the surface soil. Thus Miami silt loam is the name of a soil type within the Miami series.

Water table -- The upper limit of the part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Water-holding capacity -- The capacity (or ability) of soil to hold water against gravity (see **Field capacity**). The water-holding capacity of sandy soils is usually considered to be low while that of clayey soils is high. It is often expressed in inches of water per foot depth of soil.

Waterlogged -- A condition of soil in which both large and small pore spaces are filled with water. (The soil may be intermittently waterlogged because of a fluctuating water table or waterlogged for short periods after rain.)

CONTENTS

624.00 Definition and purpose

(a) The definition of soil quality is:
The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

(b) Considering that soil quality is the capacity of a soil to function, specific functions of concern should be clear when applying the concept. Common examples of specific soil functions are:

– Sustaining biological activity, diversity, and productivity;
– Regulating and partitioning water and solute flow;
– Filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposition;
– Storing and cycling nutrients and other elements within the earth's biosphere; and
– Providing support of socioeconomic structures (i.e. buildings, roads) and protection for archeological treasures associated with human habitation.

(c) Soil quality integrates the biological, chemical, and physical components and processes of a soil with its surroundings. Whether a research plot, field, watershed, or the earth; the concept that soil functions within a larger system remains a key consideration in assessment of soil quality.

(d) Views differ on soil quality depending on the background of individuals and their relationship to the land. Some of these views and concepts include:

– Inherent properties of soil as determined by the soil forming factors;
– Highly productive land, sustaining or enhancing productivity, maximizing profits, or maintaining the soil resource for future generations;
– Plentiful, healthful, and inexpensive food for present and future generations;
– Soil in harmony with the landscape and its surroundings; and
– Soil functioning at its potential in an ecosystem.

(e) The concept of soil quality is also viewed from various scales of concern:

– For the land manager, field or farm productivity and sustainability are important;
– For members of a community, the health or the ability of the watershed to maintain a healthy neighborhood and environment is important; and
– For national policy makers, an assessment of the overall quality and trends of the nation's soil resources are important.

624.01 Quality Concepts

Soils naturally vary in their capacity to function; therefore, an important part of the definition is the concept that quality is *specific to each kind of soil (soil map unit component)*. The quality of a soil has two distinct but related parts, inherent and dynamic qualities.

(a) Inherent quality represents intrinsic properties (qualities) of soils; as determined by the factors of soil formation--climate, topography, biota, parent material, and time. The inherent quality of soils is often used to compare the capabilities of one soil against another, and to evaluate the worth or suitability of soils for specific uses. For example, given all other determining properties being equal, a loam soil will have a higher water holding capacity than a sandy soil. Thus, the loam soil will have a higher inherent quality for storing water, and lower inherent quality for producing a freely drained condition.

(b) Many properties that have traditionally been recorded in the interpretive and taxonomic databases of the National Cooperative Soil Survey Program are not subject to change by commonly practiced soil use. They are use-invariant. Particle size distribution (texture) is an example of a use-invariant property. Since common land practices only disturb the soil to a depth of about 30 centimeters, the properties below this depth are normally use-invariant.

(c) Dynamic quality is determined by soil properties that are influenced by human use and management decisions. These properties are *use-dependent* properties and may be *temporal (dynamic)* of the soil. Bulk density near the surface and organic matter content are two such properties.

(d) Use-dependent properties most often manifest in surface and subsurface layers. These properties include physical, chemical, and biological properties. Certain management practices and uses of the land have a positive effect on specific soil properties such as increasing organic matter content. Other management practices may negatively impact the soil by causing compaction, erosion, or acidification. Collectively, management will either improve or reduce health of the soil. This dynamic aspect of soil quality is the focal point of the concern for assessing the state (or quality) of the soil resource.

(e) The reference condition is defined by a range of values for key soil properties (indicators) that represent conditions of the soil functioning at full capacity such as soil conditions under management systems that use Best Management Practices. Values for the reference condition can eventually be used as criteria in the Field Office Technical Guide for evaluating the soil condition (quality).

(f) Soil health can be evaluated relative to a standard or reference condition that represents the full capacity of a soil to function for a specific use. The reference condition is often based on use-invariant properties in conjunction with the dynamic properties. Soil properties are used to group soils that function similarly. Reference values are developed for the key properties of soils that reflect the capacity of the soil to function. Evaluation of soil quality or health must be tied to soil functions and the specific use of the soil.

(g) Soil health can also be evaluated by establishing a baseline condition for the use-dependent properties (indicators). After a period of years, the use-dependent properties are measured again and compared to the baseline.[1]

624.02 Soil Quality Test Kit (Instruction Manual)

The test kit for soil quality is on the following web site: http://soils.usda.gov/sqi/kit2.html

624.03 Soil Quality Products and Informational Documents.

The following web site contains a list of soil quality material and instructions for ordering: http://soils.usda.gov/sqi/

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Part 627 – LEGEND DEVELOPMENT AND DATA COLLECTION

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Part 627 - LEGEND DEVELOPMENT AND DATA COLLECTION

627.00 Definition and Purpose.

Soil survey legend development and documentation are those activities conducted in the field that organize, gather, describe, and delineate data needed to provide current and accurate soil maps and interpretations.

The purpose of soil survey legend and documentation procedures is to ensure the collection of meaningful and essential field data in the course of field activities. These data ensure that the objectives of the soil survey are met.

627.01 Policy and Responsibilities.

The soil survey project office is responsible for legend development and field data collection. The project office also initiates studies for soil performance data collection.

627.02 Field Studies for Legend Development.

Field studies include:

- studying the survey area in detail especially in relation to other survey areas within the same major land resource area,
- delineating major landforms, climatic zones, vegetation, and lithology within the major land resource area and the survey area,
- identifying and studying the components within the major land resource area,
- test mapping, and
- developing a descriptive legend.

(a) Studying the survey area. Soil survey field studies begin with study of the survey area and adjoining survey areas. Field studies follow the collection and review of available reference material. Visit survey areas in the same major land resource area as short reconnaissance trips. These trips assure an adequate understanding of the relationship between the survey being designed and those already completed and maintained. Join map units from adjacent soil surveys with the new survey.

(b) Identifying and delineating major units.

(1) The project office staff observes and delineates climatic zones, areas of contrasting vegetation patterns, unique landforms, such as a till plain, a terrace, a lake plain, a flood plain, or fan, and other broad ecological areas. The scientists record the delineations on a small-scale map, such as a county road map, a topographic map, or a photo index map.

(2) Next identify the components of the broad ecological areas, such as the side slope, toe slope, and foot slope components of hills, aspect differences, areas of runoff and run on, and other subdivisions of broad ecological zones. Include current and historical land use. The specifications for map unit size detailed in the memorandum of understanding dictate if these components can be delineated. Identify, describe, and classify the kinds of soils that are associated with the components. Using multiple observations, identify a preliminary range in characteristics for all the identified components in the delineated areas. Soil patterns commonly coincide with broad ecological areas and individual soils correspond with individual ecological components.

The objective of identifying and understanding the relationship between broad ecological areas and soils is to enable a soil scientist to predict the kind of soil before examining the soil profile. Expose sufficient soil profiles to ensure that the pattern is consistent. When an exposed soil profile is not what is expected, undertake additional study to understand the anomaly and variability. Further clarify the soil pattern and the relationship to ecological components. Prepare diagrams to illustrate the models.

(c) Test mapping sample areas.

(1) Design map units that represent sets of soil properties repeated on characteristic components. Map units must represent areas that can be delineated on maps and they must satisfy the objectives of the survey as detailed in the memorandum of understanding. Select sample areas that are representative of repeating patterns. Studying these sample areas in detail helps to determine the nature of the soil map unit components, their pattern of occurrence, and their size and shape. Outlining and evaluating combinations of soil characteristics create an understanding of their effect on soil behavior.

Mapping sample areas helps to test the design of the map units and to develop the descriptive legend. This process begins in the preliminary stages of the survey and continues throughout the progressive survey. Check the following:

-- the predictive value of soil-ecological area features;
-- the properties of the soil on either side of natural boundaries to determine if they differ significantly;
-- the slope gradient and shape, vegetation, and position on the landform relative to surrounding soils to determine if they help predict the kind of soil;
-- the complexity of the soil pattern;
-- the composition of mappable delineations of map units;
-- the degree that concepts of map units furnish soil data required for soil interpretations; and
-- other visual features, such as vegetation patterns, areas of rock, and photograph signature.

Describe the map units that meet these tests. These map units in conjunction with the map units of joined surveys form the first draft of the descriptive legend.

(2) Information and data collected from farmers, planners, agronomists, sanitarians, engineers, foresters, range conservationists, soil consultants, environmental scientists, and others guide the development and separation of map units. However it is important for the map units to join the adjacent soil survey areas (reference part 609.05). Compromise is sometimes necessary to ensure that surveys join. An engineer assists the soil scientists to determine the interpretations for soils as a construction material, a foundation for a structure, or other engineering use. A range scientist, forester, or other discipline specialist studies the relationship among landform, soil, and vegetation with the soil scientists when rangeland or forestland areas are important. The various disciplines work as a team in data collection and documentation.

(d) Developing provisional soil survey map units. The MLRA office or appropriate lead agency reviews and approves the first draft of the descriptive legend during the initial field review. Any soil survey project member may propose provisional map units during the course of the survey. Describe and test the provisional map units to determine if there is justification and need for the unit in the legend. When the project office is satisfied that the unit is needed, they request the MLRA office or appropriate lead to tentatively approve the unit. The approving office adds the provisional map unit to the legend object in the National Soil Survey Information System. This office also assures that the map unit description and information that justifies the map unit's addition to the legend is documented in the data mapunit object in NASIS. The project office keeps a complete record on all provisional map units. They record the acres mapped, the exact locations where the units were mapped, results of field studies, results of testing, and records of soil behavior and interpretive data. The signature on the field review report and identification legend officially approves the change of the provisional map units to approved map units.

(e) Developing a provisional general soil map.

(1) Generally the Digital General Soil Map of the U.S. (formerly called STATSGO) is the provisional and final general soil map. This general soil map serves as a guide for the soil scientists during all stages of the survey. It assists in the joining of surveys within MLRA s. The Digital General Soil Map of the U.S. serves as the final general soil map.

(2) The soil scientists refine the Digital General Soil Map of the U.S. as map unit concepts become clear and boundaries stabilize each year. States request a base map for each survey area from the National Cartography and Geospatial Center, at a scale of 1:250,000, to use in refining their general soil map. Topographic quadrangle sheets that were photographically reduced to a workable scale and joined provide contour information. Satellite imagery is also helpful. Sometimes the copy of the index map of the soil survey field sheets at the publication scale helps the refinement process. The project office updates the general soil map each year to correspond with completed soil survey field sheets. By the end of the survey, the general soil map becomes final.

627.03 Map Units of Soil Surveys.

(a) Definition. A map unit is a collection of areas defined and named the same in terms of their soil components or miscellaneous areas or both. Each map unit differs in some respect from all others in a survey area and each map unit has a symbol that uniquely identifies the map unit on a soil map. Each individual area, point, or line so identified on the map is a delineation. The project office specially designs map units to meet the needs of the major users in each major land resource area. Map units in adjoining survey areas are comparable especially within the same major land resource area.

Use any class of soil taxonomy, miscellaneous areas, and accompanying terms to name map units. A map unit has specified kinds of soil or miscellaneous areas (map unit components), each with a designated range in proportionate extent. Map units include one or more kinds of soil or miscellaneous area. Miscellaneous areas are areas that have little or no recognizable soil. The approved list is in Exhibit 627-1.

(b) Design of Map Units.

(1) Design map units to meet the objectives of the soil survey as stated in the memorandum of understanding. Consider the following items in designing a map unit:

- kinds of map units,
- phase criteria used to identify map units,
- kind and intensity of field investigation and documentation,
- soil properties for which data are required,
- minimum size management unit relevant to the various uses, and
- signature in the landscape that can be recognized from imagery, maps, or field observation.

(2) When map units consistently associate with landforms, landform segments, vegetation, slope gradient, slope aspect, geomorphic position, or other surface observable feature, the consistency of delineations improves. The correlation of map units with these surface features reduces the number of observations and samples needed to obtain a stated degree of confidence.

(3) The design of map units is flexible but should correspond to the other surveys within the MLRA. A map unit is defined by the important different kinds of soil and miscellaneous areas (components) and their proportionate extent within delineations of the map unit. Map units can have a single component or they can have many components. Chapter 2 of the *Soil Survey Manual* further discusses the design of map units.

(4) The components of a map unit are soils or miscellaneous areas. The following groups of components can help name map units:

- named soils or miscellaneous areas that are dominant and co-dominant in extent,
- similar soils or miscellaneous areas that are less extensive than the named components, and
- dissimilar soils or miscellaneous areas that are minor in extent.

Similar soil or miscellaneous area components are those that differ so little from the named components that their soil interpretations for most uses are very similar. The differences for management are small.

Dissimilar soil or miscellaneous area components are those that differ enough from the named components to affect major interpretations. The differences for management are large.

Soil components are minor in extent when they occupy a small percentage of the map unit. The percentage varies depending on how they affect the use and management of the map unit.

Generally, dissimilar components are considered minor if they are less than 15 percent and limiting to management of the map unit. If they are not limiting to the management, they can occupy up to 25 percent of the map unit and still considered minor in extent. A single component that is dissimilar and limiting should not exceed 10 percent and remain as minor extent. Also see Chapter 2 of the *Soil Survey Manual.*

Components, whether major or minor, meet the following criteria:

- exist in most delineations;
- add to the understanding of the map unit;
- are contrasting to all other components in the map unit. (Do not list similar soils as components.); and
- allow for useful and significant soil data and interpretations to the users.

Documented components that do not meet the above criteria are similar or nonrecurring or isolated features of the map unit. If appropriate, recognize nonrecurring, contrasting components with special or ad hoc features, or point or linear map unit delineations.

(5) The composition and purity of map units are important in the interpretation of soil maps. Most delineations of a map unit include dissimilar soils or miscellaneous areas of minor extent that are not identified in the map unit name but may be included in the database for the unit. Practical field mapping methods cannot delineate these components at the selected scale of mapping. But they may be associated

with a specific landform segment different from that of the named components of the map unit. Some of these components could be delineated if smaller management units were needed.

(6) Group soils that have properties similar to named components (similar soils) with the named soils.

(7) Attain a defined standard or level of confidence in the interpretative purity of map unit delineations by adjusting the kind and intensity of field investigations. If the objective of the survey requires delineation of areas of dissimilar soils as small as 2 acres in size, the soil scientist must carry out the field investigations in sufficient detail to identify accurately and consistently map 2-acre areas. Investigations that observe map unit boundaries directly and thoroughly provide greater control than those that observe map unit boundaries at moderately spaced intervals.

(c) Minimum size delineation. The memorandum of understanding for the survey area states the minimum size map unit delineation. It represents the size of an area most users would agree is the smallest area that is managed for an intended land use. The memorandum of understanding also states the map scale. The scale must accommodate legible delineations of the smallest size map unit. A legible delineation is the smallest area on the map that reasonably accommodates a map unit symbol (about 1/2 cm square).

(d) Kinds of map units. Soils differ in the size and shape of their areas, in their degree of contrast with adjacent soils, and in their geographic relationships due to soil formation or land use. Soil surveys use four kinds of map units to distinguish the different relationships: consociations, complexes, associations, and undifferentiated groups. Table 1 describes and compares these relationships.

(1) Consociations. In a consociation, delineated areas use a single name from the dominant component in the map unit. Dissimilar components are minor in extent. The soil component in a consociation may be identified at any taxonomic level. Soil series is the lowest taxonomic level.

A consociation that is named as a miscellaneous area is dominantly that kind of area and minor components do not significantly affect the use of the map unit. .

(2) Complexes and associations. Complexes and associations consist of two or more dissimilar components that occur in a regularly repeating pattern. The total amount of other dissimilar components is minor in extent.

The following arbitrary rule determines whether "complex" or "association" is used in the name. The major components of a complex cannot be mapped separately at the scale of mapping. The major components of an association can be separated at the scale of mapping. In either case, because the major components are sufficiently different in morphology or behavior, the map unit cannot be called a consociation. In each delineation of a complex or an association, each major component is normally present though their proportions may vary appreciably from one delineation to another.

(3) Undifferentiated groups. Undifferentiated groups consist of two or more components that are not consistently associated geographically and, therefore, do not always occur together in the same map delineation. These components are included in the same named map unit because their use and management are the same or very similar for common uses. Generally, they are grouped together because some common feature, such as steepness, stoniness, or flooding, determines their use and management. If two or more very steep soils that are geographically separated are so similar in their potentials for use and management that defining two or more additional map units would serve no useful purpose, they may be included in the same unit. Each delineation has at least one of the major components, and some may have all of them. The same principles regarding the proportion of minor components that apply to consociations also apply to undifferentiated groups.

Table 1 – Description of Kind of Map Unit

Type of map unit	**Map unit name from: (name soil at any taxonomic level)**	**% Dissimilar soils not included in map unit name**	Other criteria
Consociation	One soil or misc. area (similar soils or similar misc. areas included with named component)	15% limiting, 25% nonlimiting <10% of any one, limiting, very contrasting soil	
Complex	Two or more soils or misc. areas (similar soils or similar misc. areas included with named component)	15% limiting, 25% nonlimiting <10% of any one, limiting, very contrasting soil	Cannot separate the named soils or misc. on the map at the scale used.
Association	Two or more soils or misc. areas (similar soils or similar misc. areas included with named components)	15% limiting, 25% nonlimiting <10% of any one, limiting, very contrasting soil	Can separate the named soils or misc. on the map at the scale used.
Undifferentiated	2 soils or misc. area (similar soils or similar misc. areas included with named components)	15% limiting, 25% nonlimiting <10% of any one, limiting, very contrasting soil	A limitation, such as slope or salinity, overrides the primary use to such an extent that a separate map unit is not used for each soil.

627.04 Map Unit Components

Map unit components of soil survey consist of soils or miscellaneous areas. Components may be major components or minor in extent as defined in part 627.03. Major components are typically used in the map unit name. Minor components are not typically named in the map unit name but are usually shown in the database. All map unit components are fully populated with data (Part 617.01). Classify soil components at the appropriate level of soil taxonomy or leave as unnamed. Use "Unnamed" for soil components of minor extent that do not fit into or are not similar to a soil series.

Soil components of minor extent do not need to have a typical pedon. They are listed in the classification table in the correlation document.

The use of the series or higher level of taxonomy in the name does not imply that the component includes the full range of the taxonomic category. The range of characteristics of each soil component is separately determined and recorded for each specific map unit.

(a) Soil Series. The soil series is the lowest level of taxonomy. The most commonly used name for soil map unit components is the soil series name.

(b) Taxonomic categories above the series. Soil components classified in taxonomic categories above the soil series level use the classification as a soil reference term with the following conditions:

- use the spelling given in *Soil Taxonomy* for the names of components, if used as reference terms.
- a taxonomic name used as a reference term for a map unit component implies no specific range of properties beyond that which is described in the map unit description and database.
- use either taxonomic names or, preferably, a family phase name, such as Alpha family, as reference terms of the family level.

(c) Taxadjuncts. A taxadjunct is a soil (map unit component) that is correlated (named) as a recognized, existing soil series for the purpose of expediency. Taxadjuncts use a soil series name as a reference name but the soils have one or more differentiating characteristics that are outside the taxonomic class limits of the family or higher category for the named soil series. These properties in the aggregate, give responses to use and management similar to those of the named soil series.

Use taxadjuncts in lieu of establishing a soil series that would be of limited use. Part 614.04 of this handbook provides information on soil series.

To use a taxadjunct to assign a name to a map unit component, designate the map unit component as a taxadjunct in the *Component Kind* data element in the National Soil Information System. Populate the actual taxonomic classification of the taxadjunct in the component table. The representative soil properties entered for the taxadjunct must support this classification. Component text notes may be used to explain why a component is correlated as a taxadjunct.

In the final correlation memorandum, include a statement to identify that one or more map unit components using the series name is a taxadjunct (Exhibit 609-1).

In the soil survey manuscript section titled "Classification of the soils", place an asterisk in the classification table for each map unit component that is named as a taxadjunct to direct the reader to a statement explaining the taxadjunct. Include the actual classification of the taxadjunct in the classification table. List the official series classification for those components that are not taxadjuncts. Also in the manuscript, include a statement in the range in characteristics of the taxonomic unit description identifying the map units and components that are taxadjunct to the soil series and an explanation of their properties that cause them to be outside the classification of the named series.

If a map unit component has properties that are slightly outside the official series range but is in the same family as the official series, it is not a taxadjunct. Take one of two alternative actions:

(1) Widen the official series range to include the properties of the component as correlated, or

(2) Place a statement in the final correlation memorandum to explain how the component differs from the official series and why the official series was not revised to include the aberrant property or properties.

(d) Unnamed Components. An unnamed soil map unit component is a soil of minor extent within the map unit and taxonomically does not fit into any soil series. If soil components have a name or are similar to a soil series, use their name within the data mapunit list of components and in the map unit description.

(e) Miscellaneous Areas. Miscellaneous areas are components that have little or no identifiable soil as defined in *Soil Taxonomy*. Use the names of miscellaneous areas as reference terms for map unit components as they are given in Exhibit 627-1; **use no other names unless they are approved**. The MLRA office requests additions to the list of miscellaneous areas in Exhibit 627-1 or changes in the use or application of these areas. The National Soil Survey Center is responsible for approval.

Delineate map units that contain miscellaneous areas the same as other soil map units.

Describe miscellaneous areas in the map unit in terms of characteristics of the local area. Follow the generalized definitions given in Exhibit 627-1 but do not reproduce prewritten descriptions. The descriptions of miscellaneous areas include:

- at least rough proportions of nonsoil and soil components, where applicable;
- identification of included soils;
- the landform;
- the kinds of bedrock lithology;
- the nature of recent sediment; and
- drainage and runoff characteristics, if appropriate.

Small acreages of miscellaneous areas may be retained in the final correlation memorandum legend. If this legend includes miscellaneous areas, measure the units, tabulate their acreages, and list their names in the interpretative tables. If the total area is so small or of so little importance that it can not be retained in the legend, combine the areas with adjoining map units. Describe as minor components or use special symbols on the map, as appropriate.

Standard landform and miscellaneous surface features or ad hoc features are special map symbols that locate miscellaneous areas when these areas are less than the minimum size for a map unit. Their primary use is for orienting and locating features on the map to those on the ground.

(f) Phasing Components. Occasionally it is necessary to distinguish a map unit component when multiple components of the same taxonomic or miscellaneous area occur within the same map unit. Because soil properties and interpretations are shown by component, the phase helps to distinguish the correct component. Phases can be used at a local level to help identify soil components. **Do not modify the map unit component name in the database.** Use the local phase descriptor to separate components with the same name. Use a single term such as "saline" or "steep" or "sandy". It is best **not** to use a property, such as surface texture, that is entered elsewhere.

Phases of miscellaneous areas are occasionally helpful. Subclasses or phases of some miscellaneous areas show distinctions that are significant to use of the areas. An example for Pits is "gravel"; for Rock outcrop, "limestone"; and for Water, "saline".

627.05 Terms Used in Naming Map Units.

Each map unit has a name that accurately and uniquely identifies the unit within the legend used. Consistent nomenclature provides understanding to the relationships and differences among map units. Conventions for naming map units provide consistency. The soil survey project office names and defines map units according to the procedures in this handbook and the descriptions in the *Soil Survey Manual.*

The MLRA office approves map unit names and descriptions progressively with the progress of the survey and in the final correlation memorandum. The state conservationist and the MLRA office soil scientist sign the final correlation memorandum. These signatures certify that the soil survey is complete and accurate. Exhibit 609-1, item 19, provides more information.

(a) Naming Consociations.

(1) The term for the reference component or kind of miscellaneous area appears first in the map unit name. Consociations use components at all levels of soil taxonomy and kinds of miscellaneous areas as reference names.

(2) List the surface texture or any term that designates the degree of decomposition of an organic surface layer after the reference name without a comma. Examples are Alpha loam and Beta muck.

(3) If a map unit also contains a surface texture modifier, insert the appropriate term between the name of the series and the texture class or term used in lieu of texture. Examples are Alpha gravelly loam, Beta woody peat, or Gamma very parachannery ashy sandy loam.

(4) Precede all other terms with a comma. Examples are Fluvents loamy, frequently flooded; Alpha loam, 3 to 8 percent slopes, eroded; and Beta silt loam, gravelly substratum, 3 to 8 percent slopes, eroded.

(5) Separate two or more terms, other than a surface texture modifier for fragments, by commas. An example is Alpha gravelly loam, 3 to 8 percent slopes, eroded.

(6) The last term in the name is the designation for erosion, deposition, flooding, rocky, or classes of surface stones and boulders. Examples are Alpha loam, flooded and Beta gravelly loam, 0 to 3 percent slopes, stony.

(7) A designation for slope follows all other terms except those for erosion, deposition, flooding, rocky, or classes of surface stones or boulders. An example is Alpha loam, gravelly substratum, 3 to 8 percent slopes, eroded.

(8) With the exception of the word "slopes" and the terms for some texture groups, the nouns used in map unit names are singular. Chapter 2 of the *Soil Survey Manual* provides more information about consociations. Examples of appropriate names for consociations are:

-- Beta silt loam, 0 to 7 percent slopes;
-- Rock outcrop; and
-- Alpha family, 0 to 10 percent slopes.

(b) Naming Complexes.

(1) The reference names of the components form the first part of the name of a complex. Complexes use components at all levels of soil taxonomy and kinds of miscellaneous areas as reference names. Chapter 2 of the *Soil Survey Manual* gives a discussion of complexes. Two or three names that are joined by a hyphen usually form this first part. In some cases just one reference component is named in the first part, as in map units that are named for one taxon but have contrasting phase criteria. An example is Alpha complex, 0 to 3 percent slopes.

(2) If the surface textures of the components are different, the second part of the name is the word "complex," as in Alpha-Beta complex, 0 to 3 percent slopes. If the surface textures of the named components are the same, the second part of the name can be either "complex" or the common surface texture, as in Alpha-Beta silt loams, 0 to 3 percent slopes.

(3) A third part may be necessary for uniquely naming other map units. Examples are Alpha-Beta complex, rarely flooded; Beta-Theta loams, 10 to 20 percent slopes; and Beta-Rock outcrop complex, 20 to 40 percent slopes.

(4) An example of a complex named using the short family name is Alpha-Beta families, complex, 10 to 20 percent slopes.

(c) Naming Associations.

(1) The reference names of the components form the first part of the name of an association. Associations use components at all levels of soil taxonomy and kinds of miscellaneous areas as reference names. Chapter 2 of the *Soil Survey Manual* gives additional information on soil associations. Two or three names that are joined by hyphen form the first part. In some cases just one reference component is named in the first part, as in a map unit consisting of one soil that has contrasting surface texture. Examples of appropriate names are Alpha-Beta association and Alpha association, 0 to 15 percent slopes.

(2) The second part of the name is the word "association." Examples of appropriate names are Beta association; Alpha-Beta-Theta association; and Alpha-Beta families, association.

(3) A third part may be necessary for separating other phases. Examples are Beta association, 10 to 30 percent slopes; and Beta-Theta association, stony.

(d) Naming Undifferentiated Groups.

(1) The first part of the name of an undifferentiated group uses the reference name of the components. Undifferentiated groups use components at all levels of soil taxonomy and kinds of miscellaneous areas as reference names. Two names separated by "and" or three names separated by a comma and "and", respectively, form the first part. Chapter 2 of the *Soil Survey Manual* gives additional information on undifferentiated groups.

(2) The second part of the name generally is the word "soils." However, the following convention is optional . If the surface texture of the components is the same, the second part of the name is the common surface texture. Examples of appropriate names are the preferred Alpha and Beta soils and the optional Alpha and Beta silt loams, 0 to 10 percent slopes.

(3) A third part may be necessary for separating other phases. An example is Alpha, Beta, and Theta soils, moderately saline, 0 to 3 percent slopes.

(e) Naming Manmade and Modified Soils.

The soils represented by this category include a great variety of culturally disturbed earthy materials. If these materials are capable of supporting plants, the components are identified as taxa of the lowest category that provides an appropriate name. For example, a large earthen dam might be large enough to be a complex mapping unit called Dams. The components may be Ustolls for the earthen soil component and Rubble land for the riprapped miscellaneous area of the map unit. Name map units according to the conventions used for other categories of soils. If the earthy material does not qualify as soil, it receives an appropriate name for a miscellaneous area.

(f) Naming With Miscellaneous Areas. Use normal conventions for naming map units when these map units contain miscellaneous areas. Miscellaneous areas generally are capitalized in map units, but those consisting of two words have only the first word capitalized. Examples are Gullied land and Alpha-Badland complex, 15 to 45 percent slopes.

(g) Ecological Units. An ecological unit is a mapped landscape unit used for ecosystem classification and mapping.

(1) The ecological map unit uses one or more ecological types as parts of the map unit name. An ecological type has a unique combination of potential natural community, soil, geology and geomorphology, climate, and differs from other ecological types in its ability to produce vegetation and respond to management. The soil component of the ecological type must be described and correlated using the standards and guidelines described elsewhere in this handbook.

(2) The ecological map unit name consists of the names of one or more ecological types as consociations, complexes, associations, or undifferentiated map units.

(3) Name ecological types using a minimum of two-part soils and plant community name. Use classes of soil taxonomy with or without accompanying terms to name the soil portion. Incorporate geologic, geomorphic, and/or landform names, either by phases of soils, or otherwise. Use the level of soil taxonomy (series, family, or higher category) which is needed to meet the objectives of the survey. Name the plant community portion according to potential natural community.

627.06 Phases Used to Name Soil Map Units.

Two or more phase terms are commonly part of most soil map unit names. A phase term conveys important connotations about the map unit and distinguishes it from other mapping units.

Phases are not a category of the classification system, nor are they an interpretive group. Chapter 2 of the *Soil Survey Manual* provides a discussion of phases.

(a) Surface layer texture phases.

(1) Texture phases of mineral surface layers help to name map units. The texture phase name is consistent with the surface texture listed in the data mapunit in the National Soil Information System. The surface texture for the map unit name corresponds to the surface texture of the representative map unit component for the dominant land use of the map unit. Use the basic textural class names, such as sand, clay, and silt loam. Make fine distinctions in the sand fraction for the basic texture classes of sand, loamy sand, and sandy loam if:

-- these distinctions are reasonably easy to recognize and

-- these distinctions serve a useful purpose.

(2) Do not use intermediate textural groups, such as coarse textured and medium textured, to name surface texture phases. Do not use surface texture phases if map units include components named for taxonomic categories above the soil series. Chapter 3 of the *Soil Survey Manual* provides the texture terms used in the names of phases.

(3) Use terms in lieu of texture for organic surface phases, such as muck, peat, and mucky peat, to name surface layers of organic soils. Examples are Alpha muck, Beta peat, and Gamma mucky peat. Chapter 3 of the *Soil Survey Manual* describes these terms. Modify the surface layer texture phase by the addition of the texture modifier terms mucky or peaty, as appropriate, if the organic matter content of the mineral soil is more than 10 percent. An example is mucky silt loam.

(4) Chapter 2 of the *Soil Survey Manual* gives a detailed discussion of fragment phases of map units; NSSH part 618.27 and 618.67 provide more information on fragments.

(i) Modify the surface layer texture phase with a suitable adjective if fragments equal or exceed 15 percent by volume, such as Alpha gravelly loam. Use the term "very" if the fragments equal or exceed 35 percent by volume. Use the term "extremely" if they exceed 60 percent by volume. Examples are very gravelly loam and extremely gravelly loam.

(ii) Use surface phases if stones, boulders, or smaller fragments constitute more than 0.01 percent of the soil surface and they are needed to separate map units or denote important information about the map unit. Do not confuse these phases with the use of fragments as texture modifiers. For example, Alpha loam, 10 to 20 percent slopes, bouldery, is a bouldery surface phase. Part 618.61 provides more information on surface fragments.

(iii) Use a rocky phase if desired to name map units where rock outcrops make up 10 percent or less of the surface area. An example is Alpha very gravelly loam, 10 to 25 percent slopes, rocky. If rock outcrop makes up more than 10 percent of the surface area, name the map units as soil and Rock outcrop. An example is Alpha-Rock outcrop complex, 0 to 25 percent slopes. Where rockiness phases are used, both "rocky" and "very rocky" phases can be named. Commonly units with less than 2 percent rock outcrop are named "rocky" and those with 2 to 10 percent are "very rocky."

(b) Slope phases.

(1) Soil map units that have simple slopes commonly have the slope gradient range in percent following their name. Map units that have complex slopes are sometimes named in a similar manner. Use slope gradient in percent to name consociations, complexes, and undifferentiated soil groups if soil series provide the reference name. Examples are Alpha silt loam, 4 to 8 percent slopes; Alpha-Beta complex, 8 to 15 percent slopes; and Alpha, Beta, and Gamma soils, saline, 0 to 2 percent slopes.

(2) Use adjective slope terms for designating phases of map units that have complex slopes or that are named in reference to any taxonomic category above the soil series, in associations, and in some undifferentiated soil groups. Examples are Paleudalfs, steep; Alpha-Beta association, hilly; and Alpha and Beta soils, rolling.

(3) The slope phase designation follows the name of the reference taxon and other phase terms that are based on internal soil properties and is separated from them by a comma. Use the plural "slopes" if the gradient is specified in percent but omit the term if adjective names of slope classes are used.

(c) Eroded phases.

(1) Base eroded phases of a soil on significant differences in land use suitability, conservation needs, input requirements, or yields resulting from accelerated erosion. The potential for erosion is not a criterion for phases of eroded soil. Base phases of eroded soil on a comparison between the suitability for use and management needs of the eroded soil and those of the uneroded soil. Identify the phase of the eroded soil on the basis of the properties of the soil that remains. Describe an estimate of the amount of soil lost. Classes of erosion are in Chapter 3 of the *Soil Survey Manual*; and Chapter 2 gives guidelines for naming eroded soils. The classes given in Chapter 3 of the *Soil Survey Manual* are useful, but make phase separations on the basis of relative differences in soil properties and the use and management of the soil as a result of erosion and not on the basis of class definitions.

(2) Identify erosion even if genetic soil horizons have been removed throughout most of the area and the soil is a different series than it was before erosion occurred. If the original soil taxon is no longer identifiable except in isolated spots, change the reference taxon. The soil properties that exist after erosion determine the characteristic of the taxon. Designate the unit as a phase of eroded soil of the taxon as currently classified, or designate it as a complex of eroded and uneroded taxa. Examples are Udorthents-Alpha complex, eroded and Alpha, eroded-Beta complex.

(3) In many map units of eroded soils, the surface layer has not been uniformly eroded from the site. Instead, the texture, color, and thickness of the surface layer vary over short distances. Use the dominant texture to name the map unit. Describe the variability of the surface layer in the map unit description. The term designating the eroded soil phase is the last term in the name of the map unit. An example is Alpha loam, 8 to 15 percent slopes, eroded. Chapter 2 of the *Soil Survey Manual* describes the terms slightly, moderately, and severely eroded by wind and water and the term gullied .

(d) Depositional phases. In some places the soil material that was removed by wind or water deposits on other soils in amounts great enough to influence the management of the soil. If the recently deposited material is thick, consider the soil as a buried soil and do not use a depositional phase term. Refer to *Soil Taxonomy* for the definition of a buried soil. If the deposit is thinner than those limits and has not acquired the properties characteristic of the epipedon of the covered soil, name it as a depositional phase. Depositional phases are overblown, wind hummocky, and overwash. Place terms designating depositional phases last in map unit names. Examples are Alpha sandy loam, 2 to 8 percent slopes, overwash; and Beta loam, overblown. Chapter 2 of the *Soil Survey Manual* provides additional information about deposits on the surface.

(e) Depth phases.

(1) Measure depth phases from the surface of the soil down. Use depth phases to subdivide map units on the basis of depth to a component feature that is significant for purposes of the survey. A depth term, such as deep or shallow, refers to depth to bedrock unless another feature is specified. Chapter 3 of the *Soil Survey Manual* discusses root-restricting depth.

(2) Terms for depth phases identify the depth to a variety of features. The terms and their meanings are:

-- very shallow, less than 25 cm (<10 inches);
-- shallow, 25 cm to less than 50 cm (10 to <20 inches);
-- moderately deep, 50 to less than 100 cm (20 to <40 inches);
-- deep, 100 to less than 150 cm (40 to<60 inches); and
-- very deep, 150 cm or more (≥60 inches).

(3) Examples of phases for depth to a specified contrasting material are:

-- deep over basalt,
-- moderately deep over gravel,
-- moderately deep over sand,
-- shallow over clay, and
-- shallow over schist.

(4) Only specify the kind of rock in the name if it has some special value for interpretation.

(5) "Very shallow" soils are often included in "shallow." Do not give a depth designation to the most extensive phase.

(6) Place the depth terms after surface soil texture in the map unit name and separate from them by a comma. Depth precedes any terms for slope, erosion, deposition, or surface phases of soils that have stones or boulders. An example is Alpha silt loam, shallow, 6 to 8 percent slopes, moderately eroded.

(f) Substratum phases. If material in the substratum contrasts sharply with that which is normal for the taxa, identify it by specifying it in the name. The identifying terms follow the name of the taxon and surface soil texture. It precedes any terms for slope, erosion, deposition, or surface phases of soils that have stones or boulders. An example is Alpha silt loam, gravelly substratum, 6 to 20 percent slopes, eroded. Chapter 2 of the *Soil Survey Manual* lists common substratum names.

(g) Soil water phases. Soil water terms follow terms for surface soil texture and are separated from them by a comma. They precede any terms for slope, erosion, deposition, or surface phases of soils that have stones or boulders. Examples are Alpha silt loam, high water table; Beta silt loam, ponded, 0 to 1 percent slopes; and Gamma clay loam, somewhat poorly drained, 2 to 5 percent slopes, moderately eroded. Chapter 2 of the *Soil Survey Manual* gives additional information and examples of soil water phases.

(h) Saline phases. Saline phases distinguish the degrees of salinity that are important for soil use or management. In some instances, observed plant growth is evidence for saline phases. Electrical conductivity values can be used as a guide. The term used is "saline." The terms for saline phases follow any terms for surface soil texture and are separated from them by a comma. They precede any terms for slope, erosion, deposition, or surface phases of soils that have stones or boulders. An example is Alpha silt loam, saline, 1 to 3 percent slopes, very stony. Chapter 2 of the *Soil Survey Manual* gives additional information and classes of salinity.

(i) Sodic phases. For some soils, recognizing a sodic phase is useful. For example, a "sodic" phase designation added to a saline phase designation may differentiate a sodic part of a normally saline soil. Use the term "sodic" as a phase designation without terms for degrees of sodicity. The term for a sodic phase follows surface soil texture in map unit names. Separate the terms and are separated from them with a comma. It precedes any terms for slope, erosion, deposition, or surface phases of soils that have stones or boulders. An example is Alpha silt loam, strongly saline, sodic, 0 to 3 percent slopes. Chapter 2 of the *Soil Survey Manual* gives additional information on sodic phases.

(j) Physiographic phases. Landform or physiographic position can distinguish map units of a single taxon. Do not name the most common physiographic phase. Chapter 2 of the *Soil Survey Manual* gives additional information and examples of physiographic phases, and part 629.02 of this handbook gives a glossary of terms that are used to designate physiographic phases. Do not use terms not in part 629.02 unless they are approved by the National Soil Survey Center. The terms for physiographic phases follow surface soil texture in map unit names. Separate the terms with a comma. They precede any terms for slope, erosion, deposition, or surface phases of soils that have stones and boulders. An example is Alpha gravelly loam, fan, 0 to 8 percent slopes.

(k) Climatic phases. Use climatic phases to distinguish air and soil temperature, potential evaporation, wind exposure, soil moisture, and precipitation. Be sure the phases are identifiable and mappable and that the differences are significant for the purposes of the survey. The appropriate term is connotative only in reference to the common atmospheric climate for the reference taxon. Describe it specifically for each map unit to which it applies. Give the appropriate after texture. An example is Alpha sandy loam, cool. Chapter 2 of the *Soil Survey Manual* gives additional information and examples of climatic phases.

(l) Other phases. Any class of any category of the taxonomic system that is used in naming map units may be subdivided to make a phase distinction. Examples are Fluvents, rarely flooded; Typic Medisaprists, clayey substratum; and Alpha loam, occasionally flooded. Although there is a great variety of distinctions, only use those that are useful for the purposes of the survey and that can be mapped consistently. Chapter 2 of the *Soil Survey Manual* gives additional information and examples of other phases.

627.07 Soil Performance Data Collection

(a) Planning. Soil performance data collection begins by requesting assistance of discipline specialists, such as foresters, agronomists, range conservationists, engineers, soil consultants, environmental engineers, and wildlife biologists for planning and scheduling.

(b) Field study. Soil survey areas that have important riparian areas, rangeland, or forestland require field study by an interdisciplinary team. The team selects and studies sites on each important landform that has typical soils producing range plants or forestland plants. The soil scientists later study the same landforms in other land uses to determine if the soils are significantly different as a result of use. These studies may result in the development of new map units to meet user needs for soil interpretations and management decisions.

(c) Requirements. Specific requirements to adequately document rangeland, forestry, agronomy, or other soil performance are in the various discipline manuals, such as the National Forestry Manual. The actual data collection responsibilities are to be addressed in the soil survey memorandum of understanding. Part 627.09 discusses ecological site and soil correlation.

(d) Crop yields.

(1) Crop yield data from research plots and field trials are valuable in estimating yields for individual soils. Classifying and describing the soil at the plot enables the transfer of information to other sites. Always record the management practices that were used. This information goes into a data file by soil map unit component.

(2) Crop yield data that are collected from farmers' fields are a good source of data. Data entirely from one soil map unit component are especially useful.

(i) Sequential testing refers to measuring crop yields on several kinds of soil within selected farm fields. It provides valuable data because the management and weather variables are essentially held constant within a given field. Thus the effect of soil on crop yield is easier to determine.

(ii) Select fields for study to improve the understanding of soil performance on key soils. For example, to study the impacts of soil erosion, choose fields with eroded and uneroded soils of the same soil series. Obtain replications and narrow variables such as slope to a minimum.

(iii) Select sites carefully within each field to represent the soils intended for study. Randomization to better understand soil variability is not one of the purposes of sequential studies. The area of the site selected to represent a given soil map unit component should be sufficiently large to assure that the yield test will be entirely on that soil component.

(iv) At selected sites, obtain sufficient data on soil properties to complete the NRCS-SOI-1 form. In addition, consider laboratory analysis of samples to measure organic matter content, clay content, or other important properties.

(v) At the selected sites, carefully locate the boundaries or center point to enable visitations to the sites each year. Use geographic coordinates in distance from fixed points or a global positioning system. Collect yield tests over a period of several years. Multi-year data provides a better understanding of the probabilities of given yield levels. This helps in assessing the impact of erosion on yields in various weather conditions for various crops. Multi-year data also aids the evaluation of the impact of management practices on yields in crop seasons that are wetter, dryer, or shorter than normal, and for other purposes.

(3) Establish estimated yields for benchmark soils based on thorough review of yield data from all sources. Make such estimates for defined levels of management. Assembly and analyses of crop yield data for benchmark soils is an important state and major land resource area activity for NCSS agencies. Know the management practices and systems used for all yield data included in such analyses.

(i) Obtain enough yield data to evaluate various technologies in the productivity of given soils. For example, the differences in probable corn yields for no-till versus conventional tillage or for cropping systems with continuous corn, corn-soybeans, or corn following meadow in a rotation are very important. Soil scientists help assemble the needed data.

(ii) Estimate yields for crops most commonly produced on the soil. Do not give yields for crops that are not grown. The needed data are lacking for such soils. After estimating yield for benchmark soils, develop them for other soils by comparing key soil properties such as available water capacity and slope. Use multiple judgments of informed soil scientists, agronomists, and conservationists. Use caution with schemes for calculating yields.

(iii) Place yield estimates in the soil databases only after review by all states in which the map unit occurs. This is to assure that the scientists consider all yield data and all experience with a soil map unit component. Yield estimates in the soil database reflect the representative values of the soil properties that are the most important for productivity. Normally, the results are estimated yields that are applicable throughout a major land resource area. Where such applicability is not achieved, the correlation of the soil map unit component may be in error or the range in climate of the resource area may be too wide.

(iv) Yields in the soil database are for a high level of management. This is a level obtained by leading farmers that produce the highest economic returns per acre. It includes the best varieties; balancing plant populations and added nutrients to the potential of the soil; control of erosion, weeds, insects, and diseases; maintenance of optimum soil tilth; adequate soil drainage; and timely operations.

(4) USDA agencies developed an interagency USDA Soil-Crop Yield Database. Entering data into this nationwide database greatly extends the value of the data.

(i) Use NRCS-SOI-1 data form and instructions for entering data into the database. Exhibits 627-2 and 627-3 provide this information. Each state has a small supply of the form. The states reproduce this form as needed. NRCS supplies copies of the form to other agencies and instructions for its use.

(ii) If the needed soil, management, and weather data are supplied, the following kinds of crop yield data are eligible for the database. :

-- Yield measurement from commercial farm fields.

-- Yield measurements from field trials of special treatment practices (fertilizer trials, variety trials, and conservation tillage trials).

-- Yield measurements from small research plots at experiment stations or other research institutions.

(iii) Submit completed NRCS-SOI-1 forms to the National Soil Survey Center. The center arranges data entry, storage, and access.

(iv) Encourage those agencies which collect and use crop yield data to complete NRCS-SOI-1 forms. These agencies include the State Land Grant University, the Cooperative Extension Service, the Agricultural Research Service, the Farm Services Agency, the Economic Research Service, and NRCS.

627.08 Documentation.

(a) Definition. Soil survey documentation is scientific data from measurements and observations of basic soil properties and qualities and of spatial arrangements, that are collected in the field or remotely sensed using standardized procedures. This data is systematically recorded. Soil survey documentation is used to verify soil-landscape models, interpretations, and projections for use. The dominant type of documentation varies by soil order (Exhibit 627-8). The percentages of delineations that use any one type of documentation vary by the size and number of delineations of a map unit in a physiographic area. The information is presented as geographical descriptions of landscapes and boundaries, soil profiles, soil layers, chemical and physical properties, or temporal condition. It has spatial, temporal, physical, and chemical aspects. Documentation assures proper soil classification, uniform and consistent mapping, and supports inferences for application of the information to similar landscapes.

Documentation is collected over time and permanently archived. The information is cumulative. It is organized by major land resource area. Documentation progressively refines and improves soil-landscape models.

The soil survey project office organizes and analyzes support data and move it into the National Soil Information System. Field notes, including soil pedon descriptions, map unit descriptions, transects, laboratory data, and notes of an interpretive nature supplement soil maps. Soil maps and this descriptive information in the database become the primary records of a soil survey. Chapter 5 of the *Soil Survey Manual* gives helpful information about field notes and soil descriptions.

(b) Purpose of Documentation. Documentation is collected for specific outcomes within each survey area. The main outcomes are:

- To be able to develop science based soil-landscape models so we can delineate polygons of like soils
- To be able to build and store property data in a permanent database accessible to users.
- To quantify soil spatial variability in order to make logical breaks in soil landscapes.
- To better communicate with soil scientists and related professions (nomenclature, taxonomy, etc)
- To correlate ecological sites with soils
- To be able to classify and correlate soils consistently
- To be able to develop and test interpretations
    - To be able to test and report the reliability of soil survey information

(c) Specifying Documentation.

The memorandum of understanding and the project plan specify the kind and amount of support data required. The requirements for documentation written into the memorandum are based on the evaluation of the deficiencies in the map units of the previous soil survey. Reference part 610.04. For previously unmapped areas the requirements for documentation are based on the evaluation of the landscapes and map units of the surveys adjacent to the area. Generally map units that are not revised do not need further documentation other than that provided in the evaluation. Map units revised or redesigned need full documentation within the major land resource area.

Because of the variable nature of parent material, landscape patterns, uniformity, land use, user needs, scale, access, and past documentation, flexibility is needed for requirements in the type and amount of field documentation for map units within each survey area. Agreements on documentation requirements that differ from standard field description standards should be spelled out in the memorandum of understanding for each survey area before field work starts. The MLRA office should take the lead, as part of quality assurance, in assuring these standards are reasonable and adequate for correlation and interpretation and are addressed in the memorandum of understanding. Reference Exhibit 606-1.

(d) Kinds of Documentation.

(1) Field notes are essential for the preparation of the descriptive legend and soil survey manuscript because:

- many of the facts obtained in the field cannot be recorded on the map or in standard soil descriptions;
- the soil scientist cannot remember the details of all field observations, or the soil scientist may retire or transfer before completing the survey;
- they help the project office to achieve consistent work among the project members;
- they provide the data necessary for describing, classifying, and interpreting soils,
- they provide data for long term records, and
- they aid in developing and recording the map unit concept and criteria.

- Soil scientists take field notes as they progressively map the soils. They:
- record them on location at the time of the observation;
- emphasize documenting the ordinary, the prevalent, and the commonplace;
- if not a direct observation, clearly identify location, date, author, soil component, and source;
- use standard terminology and standard database programs;
- clearly separate observations from conclusions and speculations;
- summarize at regular intervals to determine the status of the documentation effort;
- add to the site observation table in NASIS, and
- file in a logical manner, preferably by map unit component and map unit, for easy reference.

Interpretive field notes are important in documenting soil behavior in the survey area. Interpretive notes result from direct observation or from information provided by resource specialists, farmers, extension personnel, agricultural teachers, fertilizer and farm equipment dealers, soil consultants, environmental scientists, county sanitarians, engineers, and other persons with experience or knowledge of soil relationships.

(2) Pedon descriptions are the primary records for soil identification, classification, and interpretation. Chapters 3 and 5 of the *Soil Survey Manual* provide helpful information, guidance, and standard terminology for describing soils. Typical pedons characterize each named component in a map unit. The soil survey project office maintains a map that locates soil description sites, especially the typical pedons. Describe soils as they occur in order to represent each map unit component. All soil descriptions are to be taken in metric units of centimeters to avoid errors of conversion. One pedon description represents each component. **It is permissible to use pedons from surveys sharing the data mapunit from within the same major land resource area and MLRA legend.** Tentatively classify all pedons at the time when they are described. After sufficient descriptions have been taken, establish a central concept and range for a kind of soil. Consult the official soil series descriptions to determine proper series placement. If the soil differs significantly from all recognized soil series in the same taxonomic family, classify the soil in the lowest possible category of soil taxonomy.

Pedons that have all soil characteristics representative of a given kind of soil often are difficult to locate or do not exist in an individual survey area. Soil scientists must objectively locate and describe pedons that are representative of the kind of soil in the area. Soil descriptions must be complete and legible. It is important to give the exact geographic location of pedons to allow for spatial analysis and revisitation of the sites.

(3) Map unit descriptions are based from the collection of field notes, transects, and soil descriptions. The notes and descriptions:

- characterize the soils within the map unit;
- determine the patterns of occurrence of different kinds of soils within the map unit, their proportionate extent, and their position on the landform; and
- determine the relationships of one map unit to another and the distinction between similar map units to support the descriptive legend.

(4) **Images**. Slides, black and white photos, digital images, and color photos taken during the soil survey illustrate and document field conditions for soil survey reports, information activities, and training sessions. Soil profiles, landscapes, vegetation patterns, typical landforms, rock exposure, and the results of management practices applied to particular soils are needed.

(5) **Soil survey investigations** may take the form of laboratory data obtained by collecting samples for chemical, physical, or engineering analysis. Other investigations may result in documentation of soil temperature, moisture, or other soil property or quality. Reference part 631 for information on soil investigations.

(e) Field Description Standards.

The soil survey project office ensures the systematic collection of documentation by providing each project member with a list of specific instructions about the kind of information needed for each map unit and soil map unit component.

The memorandum of understanding for the survey area provides guidance for the type and amount of documentation. Documentation needs and standards may vary by map unit within the same survey area. Flexibility of guidance allows for sufficient data collection for each map, yet avoids the excess time and expense of redundant or superfluous data.

(1) **Proposed series** require descriptions of at least 5 pedons for new series with an extent of less than 2,000 acres. New series with an extent of over 20,000 acres require ten pedon descriptions. The number and distribution of pedon descriptions must be adequate to classify, differentiate and develop range of characteristics. Larger acreage units require more pedons descriptions to assure reasonable spatial representation across its extent.

Laboratory data and field notes supplement these requirements. Part 614.06 of this handbook. provides helpful information on proposing a soil series.

(2) Each **map unit soil component** has a unique description. This representative pedon description exhibits typical properties and horizonation of the map unit component as it exists within the major land resource area. Each major soil component named within a map unit of the major land resource area legend requires one pedon description from the map unit. Minor components that are not named in a map unit of the legend but that occur in the component list of the database need a minimum of one pedon description. Provisional map units are exempted. This documentation is adequate for map units where the extent of the map unit is up to 3,000 acres. Where the extent is over 3,000 acres, the amount of additional descriptions are agreed upon and recorded in the memorandum of understanding. Factors that need to be considered are uniformity of material, scale, land use, and access.

To ensure that documentation is adequate for the correlation of soil component names to established soil series or higher taxonomic categories, at least three pedon descriptions are required for each taxon used in the legend. Descriptions gathered to typify the map unit component as mentioned above and descriptions within adjacent surveys within the major land resource area are included in this total.

(3) **Map units** require a minimum of 30 recorded points for each map unit to document the composition. The points need to be distributed throughout the full extent of the map unit to account for spatial variability. Depending upon the nature of the map unit, the points can come from a fixed interval transect, a line transect (points selected to represent line segments related to vegetation, hillslope position, photo tone, etc.) or other techniques to assure composition. This documentation is adequate where the extent of the map units are less than 2,000 acres. Where the extent is over 2,000 acres, add an additional 10 recorded points for each 4,000 acres. Sufficient documentation typically exists when the number of recorded points reach 60, given adequate spatial distribution. Due to unique situations and variability, the memorandum of understanding state specific requirements as needed based on uniformity of material, scale, land use, or access. Where applicable, the use of statistics can be helpful in determining the adequacy of recorded points.

(4) **Exceptions** to the minimum standards for documentation of map units and map unit components apply when adding small acreage map units along the boundary of an ongoing soil survey or modern published soil survey. Part 627.03 of this handbook provides more details on map units of small extent. In these cases use the documentation from the joining soil survey area that has the larger acreage for correlation.

The project office regularly reviews and summarizes all documentation. Where applicable, a statistical analysis of data is done to objectively evaluate soil properties and map unit composition. The descriptive legend, manuscript, and database are updated periodically based on progressively gathered documentation. Documentation undergoes a quality assurance review at regular intervals by the MLRA office. Determinations are made about the documentation in regard to:

- attaining the outcomes as stated above,
- meeting the Field Description Standards (or standards modified in the MOU), and
- identifying the need for additional documentation.

(f) Descriptive Legend. A descriptive legend is required for all soil surveys and is unique for each progressive soil survey area. A single descriptive legend may serve two or more non-progressive soil survey areas. Prepare the first draft of the descriptive legend during the preliminary study of the soils. It is available for inspection at the initial field review. At a minimum update and review the legend during annual progress reviews. The descriptive legend has four parts:

- the identification legend,
- the feature and symbol legend,
- the descriptions of map units, descriptions and classification of the soils, and
- the general soil map and legend

. Chapter 4 of the *Soil Survey Manual* also gives helpful information about the descriptive legend and survey area soil handbook.

(1) Identification legend. The identification legend consists of a list of map unit symbols and map unit names. Prepare the identification legend from map units and map unit components proposed and described. Only list those map units whose occurrence and justification were established during mapping. The soil survey project office maintains record of all symbols and proposed changes to the identification legend. Field reviews record legend changes that are approved by the MLRA office. The field review reports must account for all the map units and symbols used at any time during the survey. All field review reports include an updated identification legend. The National Soil Information System is the official depository of legends, correlation notes, and legend text. Chapter 4 of the *Soil Survey Manual* provides an example of an identification legend.

The legend is sorted numerically or alphabetically by map unit symbol. Numerically sort and publish the legend, map units, and tables where map unit symbols (or labels) are numeric or alpha-numeric. Alphabetically sort and publish the legend, map units, and tables where map unit symbols (or labels) are alphabetical.

(i) Symbols. Soil survey map unit symbols combine alpha, alpha-numeric, or numeric characters. Exhibit 627-4 gives an example. Symbols should be as short as possible, but may contain up to six characters, including special characters like hyphens. Avoid the use of the lowercase letters "i", "j", "q", and "l" because when handwritten these letters are easily confused with other letters or the number 1. Cartographically these map unit symbols are descriptive labels or labels. This is to avoid confusion with other symbols that represent specific features, such as those identified in the Feature and Symbol Legend for Soil Survey (Exhibit 627-5).

(ii) Slope phases. Identification of a slope phase with a symbol is optional. However, a capital letter (A through G) commonly identifies a map unit slope phase. Examples are AoB for Alpha loam, 3 to 6 percent slopes, and 123B for Alpha sandy loam, 3 to 6 percent slopes. If two or more slope groups, such as, 3 and 6 percent and 6 to 9 percent, combine during correlation into a map unit, such as 3 to 9 percent slopes, only use one letter to identify slope. Use the symbol for the most restrictive slope from the named components if you combine slope groups. Consider using separate components, each with their own slope group, if these components would be dissimilar.

(2) Feature and Symbol Legend for Soil Survey.

(i) Each soil survey area requires a Feature and Symbol Legend for Soil Survey (NRCS-SOI-37A 5/01). See Exhibit 627-5. The legend identifies all approved map features that may be published in soil surveys including:

-- area, line, and point soil features including soil boundary lines and soil symbols.
--ad hoc features and standard landform and miscellaneous surface features that are too small to be delineated as areas on soil map sheets at either 1:12,000 (<1.4 acres) or 1:24,000 (<5.7 acres) scale.
-- cultural features, such as structures, political boundaries, road emblems, and airports
-- hydrographic features, such as streams, springs, and wells.

The descriptions of the standard landform and miscellaneous surface features are on the back of the form NRCS-SOI-37A 5/01. If the legend includes ad hoc features, write the description on the back of the NRCS-SOI-37A 5/01.

(ii) Use standard landform and miscellaneous surface features or ad hoc features to show local areas of significantly contrasting soils or features too small to delineate at the publication scale. The need for these features depends on their significance to present or projected use of the soils and the soil map. These features are primarily for location purposes and only surface determined properties or responses define them. These features are not used to indicate soils or features that are identified in the name or description of the map unit delineated. Nor are these features used as identifying symbols in small delineations.

(iii) Define ad hoc features on the 37A in the section entitled Descriptions for Ad Hoc Features. Define the specific kind and size of the area represented.

(iv) All symbols must correspond exactly to those listed on form NRCS-SOI-37A 5/01.

(v) The soil survey project office prepares the first draft of the feature and symbol legend before the initial field review of the survey area using the NRCS-SOI-37A 5/01. The review report includes the NRCS-SOI-37A 5/01. The back of the form includes the rules of application. All subsequent progress field reviews update and approve changes to this legend. Underline or otherwise highlight those features that are selected . Only compile those features that are highlighted.

(3) Descriptions and classification of the soils.

(i) Throughout the course of the survey, the soil survey project office describes all map units and map unit components. The MLRA office approves these units before they are added to the identification legend. The soil survey project office makes minor revisions, such as adding minor components to map units, broadening the range for the taxonomic unit, or improving descriptions of the shape of delineations of the map unit.

(ii) The MLRA office approves major changes, such as the addition or deletion of a map unit or the change in concept of a taxonomic unit. The MLRA office prescribes the manner for submitting proposals for additions or deletions, and the supporting information. Make approved changes in all copies of the descriptive legend, including those used by the soil survey project office and the MLRA office or lead agency. Keep a complete record of all major revisions, and record these revisions and the reasons for them in the report of the first field review that is made after the revisions are proposed. The National Soil Information System is the official depository of legends, correlation notes, and legend text.

(iii) The MLRA office or the appropriate supervisor of the lead agency arranges procedures with cooperating agencies to obtain their concurrence to revisions of the legend.

(4) General soil map and legend. The general soil map shows the geographic distribution of general soil areas within the survey area.

(g) Survey Area Soil Handbook.

(1) Each soil survey area in which acres of field mapping are being reported includes a survey area soil handbook . The preparation of a survey area soil handbook starts at the beginning of the soil survey with the inclusion of the descriptive legend. The soil survey project office prepares and keeps current a survey area soil handbook through the life of the survey. The soil survey project office prepares an outline of the survey area soil handbook during the first year of the soil survey to meet the requirements of the survey area. The soil survey project office similarly prepares a schedule that lists target dates for completion of all major parts of the survey area soil handbook. Exhibit 608-1 and Exhibit 608-2 of this handbook provide more information. The arrangement and format of material in the survey area soil handbook is similar to that in published soil surveys. In addition to the descriptive legend, the handbook includes the soil survey manuscript prewritten material, original material that is prepared by the soil survey project office and guest authors, block diagrams, references, and pictures. The handbook is usually maintained in loose-leaf binders with dividers that separate major parts. The Exhibit 644-7 "Guide for Authors of Soil Surveys" gives information on the format and arrangement of a published soil survey. Chapter 4 of the *Soil Survey Manual* and part 609.07 of this handbook provide additional information about the soil survey area soil handbook.

(2) The survey area soil handbook receives additions and revisions as the survey progresses to reflect the knowledge gained during fieldwork. Persons who need soil data before the survey is published often use this handbook. The handbook is available in the project soil survey office and in the office of the district conservationist(s) for use and testing by other disciplines.

(3) At the time field activities conclude, the handbook encompasses the information needed to complete the manuscript for the survey area. The soil survey manuscript is essentially complete before the final field review.

627.09 Ecological Site and Soil Correlation Procedures.

(a) Definition and purpose.

Ecological site and soil correlation procedures are actions to consistently relate ecological sites and soil components. The soil is an integral part of the ecological site.

Soil survey is often an ecosystem inventory. Ecosystem inventories include not only soil and vegetation but also include the associated topography, climate, water, animals, and other living organisms. Fire and air are sometimes included. These components are interrelated. Human actions and disturbance are considered. Any disturbance exerted on one component affects other components.

Ecological site correlation relates ecosystem components within and between areas perceived as having the same historic climax plant community. Ecological site correlation procedures support consistent descriptions, documentation of the ecosystem components, and interpretations associated within the site.

Correlation is a continuous process that is initiated at the beginning of any soil or vegetation survey and progresses through a final correlation (which may also include an interstate correlation).

Soil-ecological site correlation normally takes place in conjunction with progressive soil correlation. However, ecological site correlation may also be necessary because of updates or revisions of ecological site descriptions.

The National Range and Pasture Handbook (NRPH), Chapter 3, Section 1, and the National Forestry Manual (NFM), Section 537.30(j) define ecological site correlation procedures.

(b) Records of Site Descriptions.

The Ecological Site Information System (ESIS) – Ecological Site Description database is the official repository for all data associated with ecological site descriptions. The state office is responsible for entry and maintenance of site descriptions in this database.

(c) Updating or Revising Site Descriptions.

Update site descriptions according to procedures established by NRCS in the NRPH and NFM.

(d) Juniper and pinyon communities.

For correlating sites involving juniper and pinyon communities to soils, refer to the guidelines in the USDA-NRCS publication "Inventorying, Classifying, and Correlating Juniper and Pinyon Communities to Soils in Western United States" published by the Grazing Land Technology Institute in September of 1997.

(e) Supporting information.

(1) Physiographic features -- Include copies of field sheets and any support maps (geology, topographic, slope, etc.).

(2) Climatic features -- Assemble data from nearest representative weather station(s), research or field study, soil moisture status, and soil temperature ranges.

(3) Soil features -- List the range of soil properties typifying the known range of characteristics for the site. The National Soil Information System is the official source of soil properties. Standard soil property reports from this database can show the range of individual properties for the soils included in the site.

(4) Plant community -- Complete sufficient supporting plant community data for each soil component listed in each site description. The ESIS – Ecological Site Inventory database can provide useful data in identifying plant communities. A plant association table (NRPH, Chapter 3, Section 1, 600.0302b and exhibits 3.1-1 and 3.1-2) or equivalent worksheet is helpful in identifying important plant community similarities and differences.

(5) Wildlife -- Record historical accounts, special studies, and field observations.

(6) General -- Gather field notes, photographs, and other general material.

(7) Exhibit 627-6 Ecological Site and Soil Correlation Checklist, and Exhibit 627-7 Ecological Site Checklist, help to document formal correlation activities.

(f) Interstate correlation of soils and ecological sites.

The following steps serve as a guideline for interstate correlation of soils and ecological sites. It is recommended to allow a minimum of six months to complete this process.

(1) Evaluate resource data and summaries for adequacy of use for site comparison. Include data on soils, vegetation, climate, landform, animals, and other living organisms.

(2) Exchange proposed and established site descriptions for the area.

(3) Jointly visit the sites.

(4) Document which sites can be correlated and those that cannot be correlated at this time.

(5) Make an initial grouping or separation of sites based on the criteria for comparison between sites (see 627.09 (f) and (g) of the correlation guidelines).

(6) Submit a proposal to other states for correlating comparable sites and resolving the remaining issues.

(7) Coordinate with field staff to jointly select locations to be correlated. It is not necessary to visit every site if there are no disagreements.

(8) Provide all necessary documentation (see 627.09 (h) correlation guidelines), including soil pits at the review sites.

Exhibit 627-1 Miscellaneous Areas.

Miscellaneous areas have essentially no soil and support little or no vegetation. They can result from active erosion, washing by water, unfavorable soil conditions, or human activities. Some miscellaneous areas can be made productive, but only after major reclamation efforts. The following paragraphs discuss the miscellaneous areas that are approved for use as component names. Phase additions to the following list are entered as local phase criteria but not to the component name in the database. Map unit names can include both the miscellaneous area name and the phase name. No other miscellaneous area names are to be used.

Badland is moderately steep to very steep barren land that is dissected by many intermittent drainage channels. Ordinarily, the areas are not stony. Badland is most common in semiarid and arid regions where streams cut into soft geologic material. Local relief generally ranges from 10 and 200 meters in height. Potential runoff is very high, and erosion is active.

Beaches are sandy, gravelly, or cobbly shores that are washed and rewashed by waves. The areas may be partly covered with water during high tides or storms.

Blownout land consists of areas from which all or most of the soil material has been removed by extreme wind erosion. The areas are generally shallow depressions that have flat or irregular floors. In some places the floor is a layer of material that is more resistant to wind erosion than the removed material or is a layer of pebbles or cobbles. In other places the floor may have been formed from exposure of the water table. Areas that are covered by water most of the year are mapped as Water. Some areas have a few hummocks or small dunes. Few areas of blown-out land are large enough to be delineated; small areas can be shown by spot symbols.

Chutes are elongated areas on steep mountain slopes that lack vegetation. The vegetation has been removed by avalanche or mass movement activity. Chutes consist of exposed bedrock, rock fragments, and large woody debris. Their slopes are parallel to the slope of the mountain, and their lengths are at least ten times their widths.

Cinder land is composed of loose cinders and other scoriaceous magmatic ejecta. The water-holding capacity is very low, and trafficability is poor.

Cirque land consists of areas of rock and rubble that are characteristically bowl-like and semicircular in shape. The areas have been caused by glacial erosion.

Dumps are areas of smoothed or uneven accumulations or piles of waste rock and general refuse. The phase, Dumps, mine, consist of areas of waste rock from mines, quarries, and smelters. The component name remains Dumps. Some dumps that are closely associated pits are mapped as Dumps-Pits complex.

Dune land consists of sand in ridges and intervening troughs that shift with the wind.

Glaciers are large masses of ice that formed, at least in part, on land by the compaction and recrystallization of snow. They may be moving slowly downslope or outward in all directions because of the stress of their own weight; or, they may be retreating or be stagnant. A little earthy material may be on or in the ice.

Gullied land consists of areas where erosion has cut a network of V-shaped or U-shaped channels. The areas resemble miniature badlands. Generally, gullies are so deep that extensive reshaping is necessary for most uses. Small areas can be shown by spot symbols. Phases that indicate the kind of material remaining may be useful for some areas.

Gypsum land consists of exposures of nearly pure soft gypsum. The surface is generally very unstable and erodes easily. Trafficability is very poor. Areas of hard gypsum are mapped as Rock outcrop.

Lava flows are areas covered with lava. In most humid regions, the flows are of Holcene age; but, in arid and very cold regions, they may be older. Most flows have sharp, jagged surfaces, crevices, and angular blocks that are characteristic of lava. Others are relatively smooth and have a ropy glazed surface. A little earthy material may be in a few rocks and sheltered pockets, but the flows are virtually devoid of plants other than lichens.[2/]

Oil-waste land consists of areas where liquid oily wastes, principally of saltwater and oil, have accumulated. It includes slush pits and adjacent areas that are affected by the liquid wastes. The land is barren, although some of it can be reclaimed at high cost.

Pits are open excavations from which soil and commonly underlying material have been removed, exposing either rock or other material. Phases include Pits, mine; Pits, gravel; and Pits, quarry, however, the second term is used only as phase information and not as part of a component name. Commonly, pits are closely associated with Dumps.

Playas are barren flats in closed basins in arid regions. Many of the areas are subject to wind erosion, and many are saline, sodic, or both. The water table may be near the surface sometimes.

Riverwash is unstabilized sandy, silty, clayey, or gravelly sediment that is flooded, washed, and reworked frequently by rivers.

Rock outcrop consists of exposures of bare bedrock, other than lava flows and rock-lined pits. If needed, map units can be named according to the kind of rock. If this is done, the component name remains "Rock outcrop" in the database. Examples of these phase terms are Rock outcrop, chalk; Rock outcrop, limestone; and Rock outcrop, gypsum. Many rock outcrops are too small to be delineated as areas on soil maps but can be shown by spot symbols. Some areas are large and are only broken by small areas of soil. Most rock outcrops are hard rock, but some are soft.

Rubble land consists of areas of cobbles, stones, and boulders. Rubble land is commonly at the base of mountains, but some areas are deposits of cobbles, stones, and boulders left on mountainsides by glaciation or by periglacial processes. Rubble land has a length that is less than ten times the width. A line connecting the widest points of rubble land is perpendicular to the slope of the mountain.

Salt flats are undrained flats that have surface deposits of crystalline salt overlying stratified, very strongly saline sediment. These areas are closed basins in arid regions. The water table may be near the surface sometimes.

Scoria land consists of areas of slaglike clinkers, burned shale, and fine-grained sandstone which remain after coal beds burn out. (Scoria land should not be confused with volcanic slag.)

Slickens are accumulations of fine-textured material, such as that separated in placer mine and ore mill operations. Slickens from ore mills consist largely of freshly ground rock that commonly has undergone chemical treatment during the milling process. Slickens are usually confined in specially constructed basins.

Slickspots are areas that have a puddled or crusted, very smooth, nearly impervious surface. The underlying material is dense and massive. The material ranges from extremely acid to very strongly alkaline and from sand to clay.

Uranium mined land consists of areas where uranium has been mined. The areas include the actual mines, shafts, structures, borrow pits, barren tailings and waste rock piles, evaporation ponds, and contaminated waste yards.

Urban land is land mostly covered by streets, parking lots, buildings, and other structures of urban areas.

Water includes streams, lakes, ponds, and estuaries. These areas are covered with water in most years, at least during the period that is warm enough for plants to grow. Many areas are covered throughout the year. Pits, blowouts, and playas that contain water most of the time are mapped as Water. Water is sometimes phased as Water, fresh or Water, saline in the map unit name. Water is the component name, other qualifying terms are phase criteria in database entries.

[2/] Lava flows in very wet climates which support a nearly continuous plant cover are classified as soil and not as lava flows, even though the amount of fine earth is small. Some soils of this kind have been in place for less than 100 years.

Exhibit 627-2 Example of Form NRCS-SOI-1, Soil Crop Yield Data.

ftp://npssftp.ftw.nrcs.usda.gov/ftp/forms_r2/SOI/SOI1.pdf

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

SOIL-CROP YIELD DATA

NRCS-SOI-1
1-88

1 — SAMPLE NUMBER (ST, CO, ID) | PLOT KIND | SIZE OF PLOT (WIDTH, LENGTH) | LATITUDE (DEG MIN SEC) | LONGITUDE (DEG MIN SEC) | LOCATION: OTHER DESCRIPTION | AGENCY | DATE (MO DY YR)

2 — SOIL MAP SYMBOL | SOIL MAP UNIT NAME | SOIL IDENT. AT SITE? Y/N: Y

3 — SOIL INTERP. RECORD NUMBER (ST.) | USDA TEXTURE | SLOPE (PCT) | FLOODING | OTHER PHASE CRITERIA

4 — EROSION | A HORIZON: COLOR | THICKNESS (IN) | ORGANIC MATTER (PCT) | pH | ROOT DEPTH (IN) > | SLOPE LENGTH: THRU SITE (FT), ABOVE SITE (FT) | SLOPE: KIND, SHAPE, ASPECT | K FACTOR | SURFACE AGGREGATES >84 mm | ROUGHNESS FACTOR RIDGE: HEIGHT (IN), SPACING (IN)

5 — MOISTURE RESERVE: PLANTING, GROWING | GROWING DEGREE DAYS | WEATHER: Qual., Source | PRECIPITATION BY MONTH: 1 2 3 4 5 6 7 8 9 10 11 12 | DAMAGE: DRGHT, WATER | FACTORS: R, C %

6 — MULTI-CROP N/Y: Y | CURRENT CROP | CURRENT CULTIVAR (VARIETY) | CROP HISTORY DATA — PREVIOUS CROPS: FIRST, SECOND, THIRD

7 — PLANTING INFORMATION: DATE (MO DY YR), TIMING, RATE, UNITS OF MEASURE, ROW SPACING, COVER AFTER PLTG (PCT) | HARVEST INFORMATION: DATE (MO DY YR), TIMING, STAND DENSITY, CROP YIELD, UNITS OF MEASURE | RESIDUE: T/AC, ORIENTATION

8 — SOIL TEST | COMMERCIAL FERTILIZER: LBS/AC (N, P, K), OTHER (KIND, LBS/AC) | ORGANIC MATERIALS: T/AC, KIND, CROP RES. Y/N | TILLAGE | WEED CONTROL: CHEM Y/N, NUM CULT, CROP DAM. | INSPECT/DISEASE CONTROL: CHEM Y/N, KIND TREAT, NUM APPLIC, CROP DAMAGE

9 — OTHER DAMAGE | CONS PRAC. | IRRIGATION: Y/N, TYPE, ADEQUACY | DRAINAGE: Y/N, CROP DAMAGE | FACTORS: C, P | CONSERVATION PRACTICE CODES: 1, 2, 3 | RECORDER NAME

This form was electronically produced by National Production Services Staff

Clear Form

Exhibit 627-3 Instructions for Completing Form NRCS-SOI-1, Soil Crop Yield Data.

(a) Line 1
  (1) Sample number.
    (i) State code. Use the two-character alphabetic Federal Information Processing Standards (FIPS) code, for example, VA.
    (ii) County code. Use the three-character numerical FIPS code.
    (iii) Site identification number within county. Set up a sequence of two-digit numbers for each field and another sequence of two-digit numbers for each site within the field. Keep a log of these numbers as a record for testing at the same sites in subsequent years.
  (2) Kind of plot.
    Enter one of the following codes:
    1 = Yield measurements in commercial farm fields.
    2 = Yield measurements in field trails of special treatment practices (fertilizer field trials, variety trials, conservation tillage trials).
    3 = Yield measurements of small research plots at experiment stations (variety tests, fertilizer tests).
    4 = Yield estimates.
  (3) Size of plot.
    Enter width x length in feet, for example, 4 x 10.9
  (4) Location.
    Use a map such as a 7½° quad, aerial photograph or soil survey to record the location.
    (i) X coordinate. Enter latitude north. Separate degrees, minutes, and seconds by a hyphen, for example, 25-05-03.
    (ii) Y coordinate. Enter longitude west, for example 108-25-49.
    (iii) Other location description, for example NE¼ sec. 12, T. 31 N., R. 11 W.
  (5) Agency.
    Enter the abbreviation of the agency entering the data.
  (6) Date.
    Enter the date the form is filled out, for example, 8/14/81.

(b) Line 2
  (1) Soil symbol.
    Enter the soil symbol of the area at the sample site (if known).
  (2) Soil name.
    Enter the name of the soil identified at the sample site or through reference to the soil survey, for example, NORFOLK FINE SANDY LOAM, 3-5 PERCENT SLOPE.
  (3) Soil identified at site?
    Indicate whether soil scientists identified the site. Enter Y for yes or N or no.

(c) Line 3
  (1) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  (2) USDA texture.
    Enter the textural symbols including modifier of the surface layer, for example, GR-L. Use only the approved symbols in the National Soil Survey Handbook.
  (3) Slope.
    Enter the slope to the nearest percent on slopes greater than 1 percent; enter to the nearest 0.1 percent for slopes less than 1 percent.
  (4) Flooding.
    Enter the flooding frequency (part 618.26) that most nearly represents sample site. Use NONE, VERY RARE, RARE, OCCASIONAL, FREQUENT, or VERY FREQUENT.
  (5) Other phase criteria.
    Enter phases used to name soil map unit components (part 627.06), other than surface texture, slope, or flooding, that are needed to select the correct capability and yield interpretations for the component, for example, SEVERELY ERODED.

(d) Line 4
  (1) Erosion.
    Enter the code that most nearly represents the estimate of erosion:

1 = Slight
2 = Moderate
3 = Severe

(2) Color of A horizon.
Enter the color (Munsell notation) of the A horizon.

(3) Thickness of A horizon.
Enter the thickness of the A horizon.

(4) Organic matter.
Enter an estimate or measurement of the percent of organic matter (organic carbon x 1.72) in the A horizon.

(5) pH.
Enter the pH of the surface 4 inches at the time of harvest, for example, 6.7.

(6) Rooting depth (inches).
Measure the depth to fragipan, bedrock, gravel, or other root-impeding layer. If greater than 60 inches, enter >60.

(7) Slope length.
(i) Through site (ft.). Enter the length of slope through the sample site, in feet. On terraced land enter the distance between terraces. Slope length is the distance from the point of origin of overland flow to either (a) the point where the slope decreases to the extent that deposition begins or (b) the point where runoff enters an area of concentrated flow or channel.
(ii) Above site (ft). Enter the length of slope from point or origin of overland flow to the sample point in feet.

(8) Slope.
(i) Kind.
Enter the code that most nearly represents kind of slope at the sample site:
1 = Summit
2 = Shoulder
3 = Back slope
4 = Foot slope
(ii) Shape.
Enter the code that most nearly represents the slope shape:
1 = Convex
2 = Plane
3 = Concave
4 = Undulating
5 = Complex

(9) Aspect.
On slopes where aspect is important, enter one of the 8 points of the compass that the slope faces, for example, NE.

(10) K factor.
Enter the soil erodibility (Kf) factor.

(e) Line 5

(1) Moisture reserve at planting time.
Enter one of the following codes:
1 = Above normal
2 = Normal
3 = Below normal

(2) Moisture reserve at beginning of spring growing season following fall planting (winter wheat, and rye).
Enter one of the following codes:
1 = Above normal
2 = Normal
3 = Below normal

(3) Precipitation during the growing season.
(i) Qualitative. Enter the code that represents qualitative judgment:
1 = Above normal
2 = Normal

3 = Below normal
(ii) By month. If monthly records are available, enter to the nearest inch the precipitation for each month.

(4) Drought damage.
Enter the code that represents the judgment of the amount of crop damage caused by drought:
1 = None
2 = Slight
3 = Moderate
4 = Severe

(5) Water damage.
Enter the code that describes the amount of crop damage caused by excessive wetness:
1 = None
2 = Slight
3 = Moderate
4 = Severe

(6) R factor.
Enter the R (rainfall) factor.

(f) Line 6
(1) Multiple-cropped.
Is the site double or triple cropped? Enter Y for yes, or N for no.
(2) Current crop.
Enter the crop name or code from the crop name and units of measure list in Exhibit 618-3.
(3) Cultivar (variety).
Enter the name or identification of the crop variety.
(4) Previous crops.
Enter the names or codes of the crops grown in first, second, and third previous crop seasons.

(g) Line 7
(1) Planting information.
(i) Date.
Enter the date of planting (month/day/year) if known, for example 5/15/86.
(ii) Timing.
Enter the code that describes timeliness of planting:
1 = Early
2 = Normal
3 = Late
(iii) Crop yield.
Enter the amount of harvested crop per acre, for example, 110. Use standard procedures for measuring yield.
(iv) Unit of measure.
Enter the unit of measure (Exhibit 618-3) for the crop, for example, bu/acre.
(v) Residue yield (t/acre).
Enter the air-dry tons per acre of crop residue (estimate if necessary).

(h) Line 8
(1) Commercial fertilizer.
(i) NPK
Enter the pounds of elemental nitrogen, phosphorus, and potassium applied per acre.
(ii) Other fertilizer materials (excluding lime).
(A) Specify kind, for example, ZINC.
(B) Enter the pounds per acre applied.
(2) Organic materials
(i) Enter tons of manure applied per acre.
(ii) Enter the code representing the kind of manure:
1 = Cattle
2 = Poultry
3 = Hog
4 = Horse
5 = Sludge (human)

6 = Other
(3) Crop residues returned.
Enter Y for yes, or N for no.
(4) Tillage.
Enter the code that represents the kind of tillage practice at the sample site:
1 = No till (slot tillage)
2 = Strip till
3 = Other conservation tillage
4 = Nonconservation tillage (moldboard, disk plow, lister)
(5) Weed control.
(i) Were herbicides used for this crop?
Enter Y for yes, or N for no.
(ii) Enter the number of cultivations used primarily or partly for weed control.
(iii) Enter the code that represents the extent of weed damage on this crop:
0 = None
1 = Slight
2 = Moderate
3 = Severe
(6) Insect and disease control.
(i) Were chemicals used to control insects or disease?
Enter Y for yes, or N for no.
(ii) If chemical control was used, enter the code that represents the kind of treatment:
1 = Foliage
2 = Seed
3 = Soil
4 = Two or more of the above treatments
(iii) If foliage treatment, enter the number of chemical applications.
(iv) Enter the code that represents the extent of insect or disease damage on this crop:
0 = None
1 = Slight
2 = Moderate
3 = Severe

(i) Line 9
(1) Other damage.
Enter the code that represents the extent of damage from other causes such as hail, wind, lodging, and freezing:
0 = None
1 = Slight
2 = Moderate
3 = Severe
(2) Conservation practices, other than tillage and cropping sequence.
Enter one of the following conservation practices codes. If more than one used, enter the code listed first:
0 = None
1 = Terraces
2 = Stripcropping, contour
3 = Stripcropping, field
4 = Stripcropping, wind
5 = Contour farming
(3) Irrigation.
(i) Was irrigation water applied to this crop?
Enter Y for yes, or N for no.
(ii) Type:
1 = Furrow
2 = Sprinkle
3 = Drip
4 = Flood

(iii) Enter the code that represents the adequacy of the irrigation in meeting crop moisture requirements:
1 = Good
2 = Fair
3 = Poor

(4) Drainage.

(i) Is this soil artificially drained?
Enter Y for yes, or N for no.

(ii) Enter the code that represents the damage to the crop caused by inadequate drainage system:
0 = None
1 = Slight
2 = Moderate
3 = Severe

(5) C factor.
Enter the C factor (cover and management factor used in the Revised Universal Soil Loss Equation) applicable to the site.

Exhibit 627-4 Identification Legend of Map Unit Symbols and Names

Example of an alphabetic map unit legend for Alpha County, Any State:

Map Unit Symbol	Map Unit Name
AaA	Alpha silt loam, 0 to 3 percent slopes
AaB	Alpha silty clay loam, 3 to 6 percent slopes
AAE	Alpha association, moderately steep
AAG	Alpha association, very steep
Ab	Alpha-Beta complex
AbA	Alpha, rarely flooded-Beta, occasionally flooded complex
ABG	Alpha-Beta association, very steep
BTF	Beta-Gamma association, steep
GE	Gamma and Beta soils
ROF	Rock outcrop
STC	Sigma and Gamma soils, rolling
W	Water
ZAB	Zeta association, rolling

Example of an alpha-numeric map unit legend for Beta County, Any State:

Map Unit Symbol	Map Unit Name
12A	Alpha silt loam, 0 to 2 percent slopes
12B	Alpha silt loam, 2 to 4 percent slopes
12B2	Alpha silt loam, 2 to 4 percent slopes, eroded
13	Beta silty clay loam
14	Beta silty clay loam, stony
17	Water, fresh
20	Water, saline
21	Gamma muck
23	Rock outcrop
27A	Sigma sandy loam, 0 to 2 percent slopes
29A	Sigma sandy loam, saline, 0 to 2 percent slopes
51D2	Zeta loamy sand, 8 to 15 percent slopes, eroded
52B	Zeta fine sandy loam, 2 to 5 percent slopes
52C	Zeta fine sandy loam, 5 to 8 percent slopes

Example of a numeric map unit legend for Gamma County, Any State:

Map Unit Symbol	Map Unit Name
10	Alpha silt loam, 0 to 2 percent slopes
11	Alpha silt loam, 2 to 4 percent slopes
12	Alpha silt loam, 2 to 4 percent slopes, eroded
14	Zeta fine sandy loam, 2 to 5 percent slopes
15	Zeta fine sandy loam, 5 to 8 percent slopes
16	Zeta loamy fine sand, 8 to 15 percent slopes
17	Rock outcrop
20	Beta silty clay loam
21	Beta silty clay loam, stony
60	Sigma sandy loam, 0 to 2 percent slopes
62	Sigma sandy loam, saline, 0 to 2 percent slopes
145	Gamma muck

Exhibit 627-5 Feature and Symbol Legend for Soil Survey, NRCS-SOI-37A 5/2001

Electronic version

NRCS-SOI-37A
REVISED MAY 2001

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

FEATURE AND SYMBOL LEGEND FOR SOIL SURVEY

Soil Survey Area:________

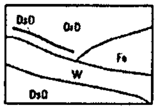
State:________

Date:________

DESCRIPTION	SYMBOL

SOIL SURVEY FEATURES

SOIL DELINEATIONS AND LABELS



STANDARD LANDFORM AND MISCELLANEOUS SURFACE FEATURES

- Bedrock escarpment
- Non-bedrock escarpment
- Gully
- Levee
- Short steep slope
- Blowout
- Borrow pit
- Clay spot
- Closed depression
- Gravel pit
- Gravelly spot
- Landfill
- Lava flow
- Marsh or swamp
- Mine or quarry
- Miscellaneous water
- Perennial water
- Rock outcrop
- Saline spot
- Sandy spot
- Severely eroded spot
- Sinkhole
- Slide or slip
- Sodic spot
- Spoil area
- Stony spot
- Very stony spot
- Wet spot

AD HOC FEATURES (Describe on back)

LABEL	SYMBOL ID	SYMBOL	LABEL	SYMBOL ID	SYMBOL
________	1		________	23	
________	2		________	24	
________	3		________	25	
________	4		________	26	
________	5		________	27	
________	6		________	28	
________	7		________	29	
________	8		________	30	
________	9		________	31	
________	10		________	32	
________	11		________	33	
________	12		________	34	
________	13		________	35	
________	14		________	36	
________	15		________	37	
________	16		________	38	
________	17		________	39	
________	18		________	40	
________	19		________	41	
________	20		________	42	
________	21		________	43	
________	22		________	44	

DESCRIPTION	SYMBOL

CULTURAL FEATURES (Optional)

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national or state forest or park)
- Limit of soil survey (label) and/or denied access areas
- Field sheet matchline and neatline
- Public Land Survey System Section Boundary
- Public Land Survey System Section Corner Tics

TRANSPORTATION

- Divided road Normally not shown
- Other road Normally not shown
- Trail Normally not shown

ROAD EMBLEMS

- Interstate
- Federal
- State
- County, farm or ranch

LOCATED OBJECTS

- Airport, airfield
- Cemetery
- Church
- Farmstead, house (omit in urban areas)
- Lighthouse
- Located object (label)
- Lookout tower
- Oil and/or natural gas well
- Other Religion (label) — Mt. Carmel
- School
- Soil sample site (compiled only not published)
- Tank (label)
- Windmill

DESCRIPTION	SYMBOL

HYDROGRAPHIC FEATURES (Optional)

- Drainage end (indicates direction of flow)
- Perennial stream
- Intermittent stream
- Unclassified stream
- Perennial drainage or irrigation ditch
- Intermittent drainage or irrigation ditch
- Unclassified drainage or irrigation ditch
- Flood pool line
- Spring
- Well, artesian
- Well, irrigation

DESCRIPTIONS FOR STANDARD LANDFORM AND MISCELLANEOUS SURFACE FEATURES

LABEL	NAME	
BLO	Blowout	A small saucer, cup, or trough-shaped hollow or depression formed by wind erosion, on a pre-existing sand deposit. Typically ___ to ___ acres.
BPI	Borrow Pit	An open excavation from which soil and underlying material have been removed, usually for construction purposes. Typically ___ to ___ acres.
CLA	Clay spot	A spot where the surface texture is silty clay or clay in areas where the surface layer is sandy loam, loam, silt loam, or coarser. Typically ___ to ___ acres.
DEP	Depression, closed	A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and is without a natural outlet for surface drainage. Typically ___ to ___ acres.
ESB	Escarpment, bedrock	A relatively continuous and steep slope or cliff produced by erosion or faulting, which breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.
ESO	Escarpment, nonbedrock	A relatively continuous and steep slope or cliff that generally is produced by erosion, but can be produced by faulting which breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil
GPI	Gravel pit	An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel. Typically ___ to ___ acres.
GRA	Gravelly spot	A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area with less than 15 percent fragments. Typically ___ to ___ acres.
GUL	Gully	A small channel with steep sides cut by running water through which water ordinarily runs only after a rain, or after ice or snow melts. It generally is an obstacle to wheeled vehicles and is too deep to be obliterated by ordinary tillage.
LDF	Landfill	An area of accumulated waste products of human habitation that can be above or below natural ground level. Typically ___ to ___ acres.
LAV	Lava flow	A solidified body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure. Often lobate in shape.
LVS	Levee	An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow of lowlands.
MAR	Marsh or swamp	A water saturated, very poorly drained area, intermittently or permanently covered by water. Marsh areas are dominantly covered by sedges, cattails and rushes. Swamps are dominantly vegetated by trees or shrubs. Not used in map units where poorly drained or very poorly drained soils are the named components. Typically ___ to ___ acres
MPI	Mine or quarry	An open excavation from which soil and underlying material are removed and bedrock is exposed. Also denotes surface openings to underground mines. Typically ___ to ___ acres.
MIS	Miscellaneous water	Small manmade water area that is used for industrial, sanitary, or mining applications and contains water most of the year. Typically ___ to ___ acres.
WAT	Perennial water	Small, natural or manmade lake, pond or pit that contains water most of the year. Typically ___ to ___ acres.
ROC	Rock outcrop	An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "Rock outcrop" is a named component of the map unit. Typically ___ to ___ acres.
SAL	Saline spot	An area where the surface layer has an electrical conductivity of 8 mmhos cm^{-1} more than surface layer of the named soils in the surrounding map unit, which has an EC of 2 mmhos cm^{-1} or less. Typically ___ to ___ acres.
SAN	Sandy spot	A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils of the surrounding map unit is very fine sandy loam or finer. Typically ___ to ___ acres.
ERO	Severely eroded spot	An area where on the average 75 percent or more of the original surface layer has been lost because of accelerated erosion. Typically ___ to ___ acres. Not used in map units that are named severely eroded, very severely eroded, or gullied.
SLP	Short, steep slope	Narrow soil area that has slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.
SNK	Sinkhole	A closed depression formed either by solution of the surficial rock or by collapse of underlying caves. Typically ___ to ___ acres.
SLI	Slide or slip	A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces. Typically ___ to ___ acres.
SOD	Sodic spot	An area where the surface layer has a sodium adsorption ratio that is at least 10 more than the surface layer of the named soils in the surrounding map unit which have a sodium adsorption ratio of 5 or less. Typically ___ to ___ acres.
SPO	Spoil area	A pile of earthy materials, either smoothed or uneven, resulting from human activity. Typically ___ to ___ acres.
STN	Stony spot	A spot where 0.01 to 0.1 percent of the surface cover is rock fragments that are greater than 10 inches in diameter in areas where the surrounding soil has no surface stones. Typically ___ to ___ acres.
STV	Very stony spot	A spot where 0.1 to 3 percent of the surface cover is rock fragments that are greater than 10 inches in diameter where the surrounding soil has less than 0.01 percent of the surface cover of stones. Typically ___ to ___ acres.
WET	Wet spot	A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit. Typically ___ to ___ acres

DESCRIPTION FOR AD HOC FEATURES

___	___	___
___	___	___
___	___	___
___	___	___
___	___	___
___	___	___

Exhibit 627-6 Ecological Site and Soil Correlation Checklist

(Use to Supplement Soil Survey Quality Assurance Worksheet)

1. Name of area (including county, state and MLRA(s)) ________________________________
____

2. Level of detail for vegetative data (indicate rangeland ecological site, forestland ecological site, rangeland similarity index, or other special studies)

3. Has soil survey memo of understanding been reviewed in regard to vegetative (rangeland, forestland, etc. (management needs)? Yes ___, No _____.

4. Do soil survey project members and field office staff have copies of site descriptions being used? Yes ____, No _____.

5. Is a site assigned to each soil component in the identification legend? Yes ____, No _____.

6. Are all sections of the ecological site descriptions written? Yes ____, No ____.

7. Does documentation for each site support all soils correlated to the site? Yes ____, No ____.

8. Field notes (how kept, by whom). ____

9. Are soil-plant relationships adequately described and documented? Yes ___, No ____.

10. Is the range of characteristics of the site description adequate? (Note kinds of deficiencies)

a. Site Characteristics:

1. Physiographic features

2. Climatic features

3. Influencing water features

4. Representative soil features

b. Plant Communities

1. Description of the vegetation dynamics of the site

2. State and transition model diagram

3. Description of the common states that occur on the site and the transitions between the states. If needed, describe the plant communities and community pathways within the state.

4. Plant community composition

5. Ground cover and structure

6. Annual production

7. Growth curves

8. Photos of each state or community

11. Are interpretations for the ecological site description adequate? (Note kinds of deficiencies)

Site Interpretations:
1. Animal community
2. Hydrology functions
3. Recreation uses
4. Wood products
5. Other products
6. Other information

12. Is the supporting information for the site description adequate? (Note kinds of deficiencies)

Supporting Information:
1. Associate sites
2. Similar sites
3. Inventory data references
4. State correlation
5. Type locality
6. Relationship to other established classification systems

13. Is the supporting information for the site description adequate to separate this site from other sites? Yes ____, No ____.

14. List of sites reviewed and status. (Indicate soils correlated to each site during this review.)

15. Have sites been correlated with existing site descriptions? Yes___No___

16. Have sites been correlated to adjoining soil survey areas? Yes___No___

17. Have sites been named and numbered correctly? Yes___No___

18. Have appropriate Federal and State agencies reviewed or assisted in writing site descriptions? Yes___No___

19. Have field office staff provided input or reviewed site descriptions? Yes___No___

20. Deficiencies noted and recommended actions. (Be specific and provide dates for completion)

21. Scheduled dates for completion of the vegetation inventory are compatible with the scheduled dates of the soil survey? Yes ____, No ____.

Date: ____________________

Signature ___________________________

Exhibit 627-7 Ecological Site Checklist

1. Name of Area(s) ______________________________
   (County(s) State(s) MLRA(s))

2. Type of Survey(s) ______________________________
   (Level of detail - soil and vegetation)

3. Participants ______________________________
   ____
   ____
   ____

4. Site Content (Number reviewed ______________________________)

   a. Field sheets, maps, etc.

   b. Range of characteristics for physiographic features:

   c. Climatic features:

   d. Water features:

   e. Soil features and official soil series descriptions:

      Range of soil properties for the site:

   f. Vegetation data (417s, etc., and plant association tables)

   g. Animal data:

   h. General (field notes, photographs, etc.)

5. Sites with deficiencies:

6. Recommended actions:

7. Site description completed ____________________(date)

Date: ______________

Signature(s) ______________________________

Exhibit 627-8 Matrix of Soil Orders and Documentation

The table below is a generalized matrix showing soil order by the dominate type of documentation.

Within physiographic areas, percentages for the number of delineations can be assigned to the entries to specify required documentation. (i.e, 25% would indicate 25 of 100 delineations)

Key type of documentation to verify or identify map units in soil delineations

	Order 1	Order 2	Order 3	Order 4
Traversing	Primary	Primary	Secondary	Secondary
Observation	----------	Secondary	Primary	Secondary
Remotely sensed/ancillary data	----------	Secondary	Primary	Primary
Key type of documentation to determine composition of a map unit				
Transecting	----------	Primary	Primary	Primary

Identification or verification of soil map units with a delineation is made by one of three methods. These methods provide documentation to the survey when the method is either recorded in the database or on the map as to type. These methods are:

-Traversing - Describing the soil and conditions at stops selected to reference vegetation, position on the landform, photo tone, etc. This is an on-site identification of the soil and verification of the projected assignment of the map unit.

-Observation - Visual notation of items as geologic features, vegetation, surface conditions, disturbed areas, etc without borings. This drive by or other sighted observation does not involve a soil examination, and instead relies on surface characteristics observed by the surveyor.

-Remotely sensed/ancillary data - includes photo tone on aerial photographs, 3-D digital elevation models, topographic maps, geology maps, vegetative maps, etc.

-Primary-the principal way polygons and properties are verified
-Secondary-additional methods in support of primary methods
-No entry -This category is generally not used in the specified order.

-Transecting - Describing the soils and conditions at points (or continuously as with GPR) along a fixed length at regular intervals or by selecting points to represent measured line segments of various patterns. Transecting is used to identify the composition of a delineation and to design a map unit. A very small percentage of the total number of delineations of any one mapping unit actually have transects unless there are very few delineations of the map unit. As soil order increases the length and intervals of the transect would generally increase. A transect is different from grid or line mapping used for determining line placement.

Part 629 – GLOSSARY OF LANDFORM AND GEOLOGIC TERMS

Table of Contents

Part 629 - GLOSSARY OF LANDFORM AND GEOLOGIC TERMS

629.00 Definition and Purpose.

The purpose of this glossary is to provide soil scientists and other specialists with a list of standard landform, geologic and related terms and their definitions to help:

- -- improve predictions of soil occurrence by ensuring that soil scientists accurately identify the landforms and sediment bodies that they encounter;
- -- improve the clarity and accuracy of map unit descriptions;
- -- ensure consistent word usage in soil topics nationwide, especially soil surveys;
- -- provide preferred or appropriate definitions for terms that have several definitions in general use;
- -- train soil scientists and other professionals in useful aspects of soils and where they occur.

629.01 Responsibilities.

This glossary is the official reference for soil survey applications of landform, geologic, and related terms. The National Soil Survey Center, Lincoln, NE, is responsible for maintaining and updating this glossary. MLRA office soil scientists and National Cooperative Soil Survey participants are responsible for submitting proposals for additions for use within soil survey descriptions and publications. Many terms and definitions are drawn from the Glossary of Geology (AGI, 1997). Permission was granted (letters dated 9/11/85 and 9/22/93) to the USDA-Natural Resource Conservation Service (formerly the Soil Conservation Service) by the American Geological Institute (AGI), to use various definitions. Modifications to original AGI definitions are noted as explained in part 629.02.

629.02 Definitions.

(a) Reference Codes.

The source from which definitions were taken, whole or in part, are identified by a code (e.g. GG) at the end of each definition. Underlined codes (e.g. GG) signify a modification of the original source definition. The reference codes are:

BFM Boothroyd, J.C., Friedrich, N.E., and McGinn, S.R. 1985. Geology of microtidal coastal lagoons: Rhode Island. Marine Geology 63:35-76.

BHM Buol, S.W., Hole, F.D., McCracken, R.J., and Southard, R.J. 1997. Soil genesis and classification, 4th Ed. Iowa State University Press, Ames, IA; 527p.

CC Cowardin, L.M., Carter, V., Golet, F.C., and Laroe, E.T. 1979. Classification of wetlands and deepwater habitats of the United States. US Dept. Interior, US Fish and Wildlife Service, US Government Printing Office, Washington, DC.

CF Clayton, L. and Freers, T.F. (eds.) 1967. Glacial geology of the Missouri Coteau and adjacent areas. Guidebook 18th annual field conference Midwest Friends of the Pleistocene. North Dakota Geological Survey Miscellaneous Series #30, 170 p.

CV Cruden, D.M., and Varnes, D.J. 1996. Landslide types and processes. *In:* Turner, A.K., and Schuster, R.L., (eds). 1996. Landslides: investigations and mitigation. National Research Council, Transportation Research Board Special Report No. 247; National Academy Press, Washington, DC; 673 p.

DV Varnes, D. 1978. Slope movement types and processes. *In:* Schuster, R.L., and R.J. Krizek. (eds). 1978. Landslides: analysis and control. National Academy Sciences, Transportation Research Board Special Report No. 176; 234 p.

FC Freeze, A.L. and Cherry, J.A. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ, 604 p.

FFP Peterson, F.F. 1981. Landforms of the Basin and Range Province defined for soil survey. Nevada Agricultural Experiment Station Technical Bulletin No. 28, Reno, NV. 52p.

GG Jackson, J.A. (ed) 1997. Glossary of geology, 4th Ed. American Geological Institute, Alexandria, VA. 769p. ISBN 0-922152-34-9

GG'87 Bates, R.L., and Jackson, J.A. (ed) 1987. Glossary of geology, 3rd Ed. American Geological Institute, Alexandria, VA.788p.

DA Davis, R.A. 1994. Barrier island systems - a geologic overview. P. 1-46. *In:* Davis, R.A. ed.) 1994. Geology of Holocene barrier island systems. Springer-Verlag, New York, NY.

DR Ritter, D.F., Kochel, R.C., and Miller, J.R. 1995. Process geomorphology, 3rd ed. Wm. C. Brown, Publishers, Dubuque, IA.

FS Fisher, J.J., and Simpson, E.J. 1979. Washover and tidal sedimentation rates as environmental factors in development of a transgressive barrier shoreline; pp.127-148. *In:* Leatherman, S.P. (ed.) 1979. Barrier islands from the Gulf of St Lawrence to the Gulf of Mexico. Academic Press, New York, NY.

GD Demas, G.P. 1998. Subaqueous soil of Sinepuxent Bay, Maryland. PhD dissertation, Department of Natural Resources and Landscape Architecture, University of Maryland, College Park, MD.

GHG Gile, L.H., Hawley, J.W., and Grossman, R.B. 1981. Soils and geomorphology in the Basin and Range area of southern New Mexico – Guidebook to the Desert Project. Memoir 39. New Mexico Bureau of Mines & Mineral Resources, Socorro, NM; 222 p.

GM Goldthwaite, R.P. and Matsch, C.L. (eds.) 1988. Genetic classification of glaciogenic deposits: final report of the commission on genesis and lithology of glacial Quaternary deposits of the International Union for Quaternary Research (INQUA). A.A. Balkema, Rotterdam; 294 p.

GS Green, J., and Short, N.M. 1971. Volcanic landforms and surface features: A photographic atlas and glossary. Springer – Verlag, New York, NY. 519 p.

GSST Soil Science Society of America. 2001. Glossary of Soil Science terms. Soil Science Society of America, Madison, WI. 135p.

HD Holdorf, H. and Donahue, J. 1990. Landforms for soil surveys in the Northern Rockies. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Misc. Publ. No. 51. 26 p.

HF Fisk, H.N. 1959. Padre Island and the Laguna Madre flats, coastal south Texas. Louisiana State University, 2nd Coastal Geography Conference; pp. 103-151.

HP Hawley, J.W., and Parsons, R.B. 1980. Glossary of selected geomorphic and geologic terms. Mimeo. USDA Soil Conservation Service, West National Technical Center, Portland, OR. 30 p.

KST Soil Survey Staff. 1994. Keys to Soil Taxonomy, 6th Ed. USDA - Natural Resources Conservation Service (p.54).

MA MacDonald, G.A. and A.T. Abbott. 1970. Volcanoes in the sea, the geology of Hawaii. University of Hawaii Press, 441p.

NL Lancaster, N. 1995. Geomorphology of desert dunes. Routledge, New York, NY. 209p.

NRC National Research Council of Canada. 1988. Glossary of permafrost and related ground ice terms. Associate Committee Geotechnical Research, Technical Memorandum 142; 156 p

RF Fairbridge, R .W. (ed.). Encyclopedia of geomorphology. 1968. Encyclopedia of Earth Sciences Series, vol. 3. Reinhold Book Corporation, New York, NY

RD Daniels, Raymond B. (personal communication).

RR Ruhe, Robert V. 1975. Geomorphology: Geomorphic processes and surficial geology. Houghton-Mifflin, Boston, MA, 246p.

SJ Sugden, D.E. and John, B.S. 1976. Glaciers and landscape, a geomorphological approach. Halsted Press, John Wiley and Sons, Inc., New York, NY, 376 p.

SM McGinn, S.R. 1982. Facies distribution of Ninigret Pond. Masters thesis, University of Rhode Island, Kingston, RI.

SS Summer, M.E., and Stewart, B.A. (eds). 1992. Soil crusting in Australia. *In:* Soil crusting: chemical and physical process. Advances in Soil Science, Lewis Publishing, Boca Raton, FL.

SSM Soil Survey Staff. 1993. Soil Survey Manual. USDA - Soil Conservation Service, Agricultural Handbook No. 18, U.S. Gov. Print. Office, Washington, DC.

SSS Subaqueous Soils Subcommittee. 2005. Glossary of terms for subaqueous soils, landscapes, landforms, and parent materials of estuaries and lagoons. National Cooperative Soil Survey Conference, USDA-NRCS, National Soil Survey Center, Lincoln, NE.

ST Soil Survey Staff. 1975. Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys. USDA - Soil Conservation Service Agricultural Handbook #436, U.S. Gov. Print. Office, Washington, DC, 754 p.

SW Schoeneberger, P.J. and Wysocki, D.A. (personal communication), National Soil Survey Center, NRCS, Lincoln, NE.

WA Way, D.S. 1973. Terrain analysis. Harvard University, Dowden, Hutchinson & Ross, Inc., Stroudsburg, PA. 392p.

WCHP Wells, D.V., Conkwright, R.D., Hill, J.M., and Park, M.J. 1994. The surficial sediments of Assawoman Bay and Isle of Wight Bay, Maryland: Physical and chemical characteristics. Coastal and Estuarine Geology File Report Number 94-2, Maryland Geological Survey, Baltimore, MD.

WM Monroe, W.H. 1980. Some tropical landforms of Puerto Rico. US Geological Survey Professional Paper 1159, U.S. Govt. Print. Office, Washington, DC.

WT Thornbury, W.D. 1969. Principles of geomorphology; 2nd Ed. John Wiley and Sons, Inc., New York, NY; 594 p.

WW White, W.B. 1988. Geomorphology and hydrology of karst terrains. Oxford Univ. Press, New York, NY; 478 p.

(b) Clarifying comments attached to glossary terms.

... (not recommended) use ...- indicates terms that are unacceptable (erroneous, obsolete, ill-defined, chronically misapplied, or otherwise inappropriate for use in a soils context) and should not be used. If available, an alternate term is indicated.

... (not preferred) refer to ... - identifies terms that may be technically correct (theoretically acceptable) but are not desirable and should not be used, if at all possible, due to unnecessary redundancy or confusion. Preferred alternatives are indicated.

... (colloquial:) - indicates a local term; **one not widely recognized**, and identifies the area where it has been used, **if known**. Its definition or usage is either not widely accepted or unknown outside the specified area. A colloquial term should not be used if a more widely recognized alternative is available.

Compare - ...... - Found at the end of a definition and indicates other glossary terms that are related or similar to, yet different from, the term they follow.

(c) Glossary terms.

\`a\`a lava - A type of basaltic lava (material) having a rough, jagged, clinkery surface and a vesicular interior. Compare – block lava, pahoehoe lava, pillow lava. GG & MA

\`a\`a lava flow - A type of basaltic lava flow dominated by **\`a\`a** lava and a characteristically rough, jagged, clinkery surface. Compare - pahoehoe lava flow. Compare – block lava flow, pahoehoe lava flow, pillow lava flow. GG & MA

ablation till - A general term for loose, relatively permeable, earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier. Compare - till, ground moraine. GG

accretion [sedimentology] - The gradual increase or extension of land by natural forces acting over a long period of time, as on a beach by the washing up of sand from the sea or on a flood plain by the accumulation of sediment deposited by a stream. Synonym: aggradation. GG

active layer - The top layer of ground subject to annual thawing and freezing in areas underlain by permafrost. NRC

active slope - (not recommended)

aeolian - (not recommended; obsolete) use eolian.

aggradation - The building-up of the Earth's surface by deposition; specifically, the accumulation of material by any process in order to establish or maintain uniformity of grade or slope; **also called accretion**. Compare - degradation. GG

alas - A type of thermokarst depression with steep sides and a flat, grass-covered floor, found in thermokarst terrain, produced by thawing of extensive areas of very thick and exceedingly ice-rich permafrost. Compare - thermokarst depression. NRC and GG

alluvial - Pertaining to material or processes associated with transportation and/or subaerial deposition by concentrated running water. Compare - colluvial. GSST

alluvial cone – A semi-conical type of alluvial fan with very steep slopes; it is higher, narrower, and steeper (e.g., > 40% slopes) than a fan, and composed of coarser, and thicker layers of material deposited by a combination of alluvial episodes and to a much lesser degree, landslides (e.g., debris flow). Coarsest materials tend to be concentrated at the apex of the cone. Compare – alluvial fan, talus cone. SW

alluvial fan - A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream (best expressed in semiarid regions) at the place where it issues from a narrow mountain or upland valley; or where a tributary stream is near or at its junction with the main stream. It is steepest near its apex which points upstream and slopes gently and convexly outward (downstream) with a gradual decrease in gradient. GG

alluvial flat - (a) (colloquial: western U.S.A.) A nearly level, graded, alluvial surface in bolsons and semi-bolsons which commonly does not manifest traceable channels, terraces or flood plain levels. Compare – flood-plain step, terrace, valley flat. FFP, GG, & SW. (b) (not preferred) A general term for a small flood plain bordering a river, on which alluvium is deposited during floods. GG

alluvial plain - (a) A large assemblage of fluvial landforms (braided streams, terraces, etc.,) that form low gradient, regional ramps along the flanks of mountains and extend great distances from their sources (e.g., High Plains of North America. SW (b) (not recommended, use flood plain.) A general, informal term for a broad flood plain or a low-gradient delta. Compare - alluvial flat. FFP.

alluvial plain remnant - An erosional remnant of an alluvial plain which retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to a present-day stream or drainage network. Compare - alluvial plain, erosional remnant, paleoterrace. SW

alluvial terrace - (not preferred) refer to stream terrace.

alluvium - Unconsolidated, clastic material subaerially deposited by running water, including gravel, sand, silt, clay, and various mixtures of these. Compare - colluvium, slope alluvium. HP

alpine - (a) [geomorphology] - (adjective) Characteristic of, or resembling the European Alps, or any lofty mountain or mountain system, especially one so modified by intense glacial erosion as to contain cirques, horns, etc. (ex. alpine lake) GG ; (b) (not recommended as a landform term). An ecological community term for high-elevation plant communities. SW & GG

alpine glacier – a) Any glacier in a mountain range except an ice cap or ice sheet. It usually originates in a cirque and may flow down into a valley previously carved by a stream. Compare – continental glacier. GG b) (not preferred – refer to U-shaped valley): (relict) - landforms or sediments formed, modified or deposited by a glacier in or on mountains or high hills that has since melted away. Compare – glacial-valley floor, glacial-valley wall. SW

angle of repose - The maximum angle of slope (measured from a horizontal plane) at which loose, cohesionless material will come to rest. GG

annular drainage pattern – A drainage pattern in which subsequent streams follow a roughly circular or concentric path along a belt of weak rocks, resembling in plan view, a ring-like pattern where the bedrock joints or fracturing control the parallel tributaries. It is best displayed in streams draining a maturely dissected granitic or sedimentary structural dome or basin where erosion has exposed rimming sedimentary strata of greatly varying degrees of hardness, as in the Red Valley which nearly encircles the domal structure of the Black Hills, SD. SW & GG & WA

anthropogenic feature - An artificial feature on the earth's surface (including those in shallow water), having a characteristic shape and range in composition, composed of unconsolidated earthy, organic materials, artificial materials, or rock, that is the direct result of human manipulation or activities; can be either constructional (e.g., artificial levee) or destructional (quarry). SW

anticline - (a) [landform] A unit of folded strata that is convex upward and whose core contains the stratigraphically oldest rocks, and occurs at the earth's surface. In a single anticline, beds forming the opposing limbs of the fold dip away from its axial plane. Compare - monocline, syncline, fold. SW & HP
(b) [structural geology] A fold, at any depth, generally convex upward whose core contains the stratigraphically older rocks. GG

aquiclude - A layer of soil, sediment, or rock that may or may not be saturated, that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients. Compare – aquitard. FC

aquifer - A saturated, permeable geologic unit of sediment or rock that can transmit significant quantities of water under hydraulic gradients. FC

aquitard - A body of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs but may serve as a storage unit for groundwater. GG

arete - A narrow, jagged mountain crest, often above the snowline, sculptured by alpine glaciers and formed by backward erosion of adjoining cirque walls. HP

arroyo - (colloquial: southwest U.S.A.) The channel of a flat-floored, ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material; sometimes called a wash. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed. Where arroyos intersect zones of ground-water discharge, they are more properly classed as intermittent stream channels. HP

artificial collapsed depression – A collapse basin, commonly a closed depression, which is the direct result of surficial subsidence associated with subsurface mining (e.g., long-wall mining). SW.

artificial drainage pattern – Human-made networks of drainage structures (ditches, canals, etc.) built primarily to lower or control the local water table in low lying, flat topography such as glacial lakebeds, broad flood plains, low coastal plains, or marshes most commonly in humid climates. (Irrigation ditches found in arid and semiarid climates, which bring water into the fields, should not be confused with drainage structures). SW & WA

artificial levee - An artificial embankment constructed along the bank of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel. GG

ash [volcanic] - Unconsolidated, pyroclastic material less than 2 mm in all dimensions. Commonly called "volcanic ash" Compare - block [volcanic], cinders, lapilli, tephra. SW & KST

ash flow - (not preferred – see pyroclastic flow, pyroclastic surge) A highly heated mixture of volcanic gases and ash, traveling down the flank of a volcano or along the surface of the ground; produced by the explosive disintegration of viscous lava in a volcanic crater, or by the explosive emission of gas-charged ash from a fissure or group of fissures. The solid materials contained in a typical ash flow are generally unsorted and ordinarily include volcanic dust, pumice, scoria, and blocks in addition to ash. (Also called a *pyroclastic* flow.) Compare - nueé ardente, lahar, pyroclastic. GG

aspect - The direction toward which a slope faces with respect to the compass or to the rays of the Sun; also called *slope* aspect. GSST

atoll - A coral reef appearing in plan view as roughly circular, and surmounted by a chain of closely spaced, low coral islets that encircle or nearly encircle a shallow lagoon in which there is no land or islands of non-coral origin; the reef is surrounded by open sea. GG

avalanche - A large mass of snow, ice, soil, or rock, or mixtures of these materials, falling, sliding, or flowing very rapidly under the force of gravity. Velocities may sometimes exceed 500 km/hr. GG

avalanche chute - [preferred term] The central, channel-like corridor, scar, or depression along which an avalanche has moved. An eroded surface marked by pits, scratches, and grooves. GG

avalanche track - (not recommended as a landform term - use avalanche chute). The path formed by an avalanche. It may take the form of an open path in a forest, with bent and broken trees, or an eroded surface marked by pits, scratches, and grooves. Compare - avalanche chute GG

avulsion - A sudden cutting off or separation of land by a flood or by abrupt change in the course of a stream, as by a stream breaking through a meander or by a sudden change in current whereby the stream deserts its old channel for a new one. Compare - crevasse, flood-plain splay. GG

axial stream - (a) The main stream of an intermontane valley, flowing in the deepest part of the valley and parallel to its longest dimension. (b) A stream that follows the axis of a syncline or anticline. GG

back-barrier beach - A narrow, elongate, intertidal, sloping landform that is generally parallel with the shoreline located on the lagoon or estuary side of the barrier island, or spit. Compare – barrier island. SSS

back-barrier flat - A subaerial, gently sloping landform on the lagoon side of the barrier beach ridge composed predominantly of sand washed over or through the beach ridge during tidal surges; a portion of a barrier flat. Compare – washover-fan flat. SSS

backshore - The upper or inner, usually dry, zone of the shore or beach, lying between the high-water line of mean spring tides and the upper limit of shore-zone processes; it is acted upon by waves or covered by water only during exceptionally severe storms or unusually high tides. It is essentially horizontal or slopes gently landward, and is divided from the foreshore by the crest of the most seaward berm. Compare - washover fan. GG

backshore terrace - (not preferred) refer to berm.

backslope - The hillslope profile position that forms the steepest and generally linear, middle portion of the slope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below. They may or may not include cliff segments (i.e. free faces). Backslopes are commonly erosional forms produced by mass movement, colluvial action, and running water. Compare - summit, shoulder, footslope, toeslope. GSST & HP

backswamp - A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces. Compare - valley flat. HP

backswamp deposit - Laminated of silt and clay deposited in the flood basin between valley sides or terraces and the natural levees of a river. Compare - slackwater. GG

backwearing - Slope erosion that causes the parallel retreat of an escarpment or the slope of a hill or mountain or the sideways recession of a slope without changing its general slope; a process contributing to the development of a pediment. GG

badlands - A landscape which is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes with narrow interfluves. Badlands develop on surfaces with little or no vegetative cover, overlying unconsolidated or poorly cemented materials (clays, silts, or in some cases sandstones) sometimes with soluble minerals such as gypsum or halite. GG

bajada - (colloquial: southwestern U.S.A.) A broad, gently inclined, alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins. Synonym - coalescent fan piedmont. Compare - fan apron. HP & SW

bald – (not preferred; colloquial: southeastern USA; use summit, mountaintop, etc.) An ecological term for the grass or shrub covered (naturally tree-less) summit of a high elevation hill or mountain, flanked by forested slopes; not above the local tree-line. Compare – glade. SW & GG

ballena - (colloquial: western U.S.A.) A fan remnant having a distinctively-rounded surface of fan alluvium. The ballena's broadly-rounded shoulders meet from either side to form a narrow summit and merge smoothly with concave side slopes and then concave, short pediments which form smoothly-rounded drainageways between adjacent ballenas. A partial ballena is a fan remnant large enough to retain some relict fan surface on a remnant summit. Compare - fan remnant. SW & FFP.

ballon - (colloquial: western U.S.A.) A rounded, dome-shaped hill, formed either by erosion or uplift. GG

bar - [streams] A general term for a ridge-like accumulation of sand, gravel, or other alluvial material formed in the channel, along the banks, or at the mouth of a stream where a decrease in velocity induces deposition; e.g. a channel bar or a meander bar. [coast] - A generic term for any of various elongate offshore ridges, banks, or mounds of sand, gravel, or other unconsolidated material submerged at least at high tide, and built up by the action of waves or currents, especially at the mouth of a river or estuary, or at a slight distance offshore from the beach. Compare - longshore bar. GG & GSST

bar [Microfeature] – A small, sinuous or arcuate, ridge-like lineation on a flood plain and separated from others by small channels or troughs; caused by fluvial processes and common to flood plains and young alluvial terraces; a constituent part of *bar and channel topography*. Compare – meander scroll. SW

bar and channel topography – A local-scale topographic pattern of recurring, small, sinuous or arcuate ridges separated by shallow troughs irregularly spaced across low-relief flood plains(slopes generally 2 –6 %); the effect is one of a subdued, sinuously undulating surface that is common on active, meandering flood plains. Micro-elevational differences between bars and channels generally range from <0.5 to 2 m and are largely controlled by the competency of the stream. The ridge-like bars often consist of somewhat coarser sediments compared to the finer textured sediments of the micro-low troughs. Compare – meander scroll, meander belt. SW

barchan dune - A crescent-shaped dune with tips extending leeward (downwind), making this side concave and the windward (upwind) side convex. Barchan dunes tend to be arranged in chains extending in the dominant wind direction. Compare - parabolic dune. HP

barrier bar - (not recommended) use longshore bar

barrier beach - (a) A narrow, elongate, coarse-textured, intertidal, sloping landform that is generally parallel with the beach ridge component of a barrier island or spit and adjacent to the ocean. Compare – barrier island. SSS (b) [relict] (colloquial: western U.S.A.) A wide, gently-sloping portion of a bolson floor comprising numerous, parallel, closely-spaced, relict longshore-bars and lagoons built by a receding pluvial lake. Synonym, offshore barrier, offshore beach, bar beach. Compare - bar [coast], barrier island. GG and FFP

barrier cove - A subaqueous area adjacent to a barrier island or submerged barrier beach that forms a minor embayment or cove within the larger basin. Compare – cove, mainland cove. SSS

barrier flat - A relatively flat, low-lying area, commonly including pools of water, separating the exposed or seaward edge of a barrier beach or barrier island from the lagoon behind it. An assemblage of both deflation flats left behind migrating dunes and /or storm washover sediments; may be either barren or vegetated. Compare – barrier beach, back-barrier flat. SSS

barrier island - A long, narrow, sandy island, that is above high tide and parallel to the shore that commonly has dunes, vegetated zones, and swampy **or marshy** terrains extending lagoonward from the beach. Compare – barrier beach. GG

barrow pit - (not preferred) refer to borrow pit

basal till - (a) (not preferred; obsolete) refer to subglacial till. Unconsolidated material of mixed composition deposited at the base (bottom) of a glacier [The term emphasizes only the relative position of deposition; e.g. subglacial till]. Types of basal till include lodgment, melt-out, and flow till. GG & SW (b) [obsolete- use lodgment till] - A firm, dense, clay-rich till containing many abraded stones (coarse fragments) dragged along beneath a moving glacier and deposited upon bedrock or other glacial deposits. GG

base level - The theoretical limit or lowest level toward which erosion of the Earth's surface constantly progresses but seldom, if ever, reaches; especially the level below which a stream cannot erode its bed. The general or ultimate base level for the land surface is sea level, but temporary base levels commonly exist locally. GG

base slope [geomorphology] - A geomorphic component of hills consisting of the concave to linear slope (perpendicular to the contour) which, regardless of the lateral shape is an area that forms an apron or wedge at the bottom of a hillside dominated by colluvial and slope wash processes and sediments (e.g., colluvium and slope alluvium). Distal base slope sediments commonly grade to, or interfinger with, alluvial fills, or gradually thin to form pedisediment over residuum. Compare - head slope, side slope, nose slope, interfluve, free face. SW

basin - (a) Drainage basin; (b) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated. GG (c) (colloquial: western USA) A general term for the nearly level to gently sloping, bottom surface of an intermontane basin (bolson). Landforms include playas, broad alluvial flats containing ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely, if ever, are subject to flooding. Where through-drainage systems are well developed, flood plains are dominant and lake plains are absent or of limited extent. Basin floors grade mountainward to distal parts of piedmont slopes. FFP

basin floor - A general term for the nearly level, lower-most part of intermontane basins (i.e. bolsons, semi-bolsons). The floor includes all of the alluvial, eolian, and erosional landforms below the piedmont slope. Compare - basin, piedmont slope. FFP

basin-floor remnant - (colloquial: western U.S.A.) A relatively flat, erosional remnant of any former landform of a basin floor that has been dissected following the incision of an axial stream. FFP

batholith – A large, generally discordant plutonic rock body exposed at the land surface, with an aerial extent > 40 sq. mi. (100 km^2) and no known bottom (e.g. Idaho batholith). Compare – stock. SW & GG

bay [coast] – a) A wide, curving open indentation, recess, or arm of a sea (e.g. Chesapeake Bay) or lake (e.g. Green Bay, WI) into the land or between two capes or headlands, larger than a cove [coast], and usually smaller than, but of the same general character as, a gulf. b) A large tract of water that penetrates into the land and around which the land forms a broad curve. By international agreement a bay is a water body having a baymouth that is less than 24 nautical miles wide and an area that is equal to or greater than the area of a semicircle whose diameter is equal to the width of the bay mouth. Compare – gulf. GG

bay [geom.] - (a) Any terrestrial formation resembling a bay of the sea, as a recess or extension of lowland along a river valley or within a curve in a range of hills, or an arm of a prairie extending into, or partly surrounded by, a forest. (b) A Carolina Bay. GG & GSST.

bay bottom - The nearly level or slightly undulating central portion of a submerged, low-energy, depositional estuarine embayment characterized by relatively deep water (1.0 to >2.5 m). Compare – lagoon bottom. SSS

bayou - A term applied to many local water features in the lower Mississippi River basin and in the Gulf Coast region of the U.S. Its general meaning is a creek or secondary watercourse that is tributary to another body of water; especially a sluggish and stagnant stream that follows a winding course through alluvial lowlands, coastal swamps or river deltas. Compare - oxbow, slough. GG

beach - (a) A gently sloping zone of unconsolidated material, typically with a slightly concave profile, extending landward from the low-water line to the place where there is a definite change in material or physiographic form (such as a cliff) or to the line of permanent vegetation (usually the effective limit of the highest storm waves); a shore of a body of water, formed and washed by waves or tides, usually covered by sand or gravel; (b) the relatively thick and temporary accumulation of loose water-borne material (usually well-sorted sand and pebbles) accompanied by mud, cobbles, boulders, and smoothed rock and shell fragments, that is in active transit along, or deposited on, the shore zone between the limits of low water and high water. GG

beach plain - A continuous and level or undulating area formed by closely spaced successive embankments of wave-deposited beach material added more or less uniformly to a prograding shoreline, such as to a growing compound spit or to a cuspate foreland. Compare - wave-built terrace, chenier plain. GG

beach ridge - A low, essentially continuous mound of beach or beach-and-dune material heaped up by the action of waves and currents on the backshore of a beach, beyond the present limit of storm waves or the reach of ordinary tides, and occurring singly or as one of a series of approximately parallel deposits. The ridges are roughly parallel to the shoreline and represent successive positions of an advancing shoreline. GG

beach sands [soil survey] – Well sorted, sand-sized, clastic material transported and deposited primarily by wave action and deposited in a shore environment. Compare - eolian sands. SW

beach terrace - (a) A landform that consists of a wave-cut scarp and wave-built terrace of well-sorted sand and gravel of marine and lacustrine origin. (b) (colloquial: western U.S.A.) relict shorelines from pluvial lakes, generally restricted to valley sides. Compare - strandline, shoreline. FFP

beaded drainage pattern - (not recommended; use beaded stream pattern.)

beaded stream pattern - A characteristic pattern of small streams in areas underlain by ice wedges. The course of the stream channel is controlled by the pattern of the wedges, with beads (pools) occurring at the junctions of the wedges. NRC

bed [stratigraphy] - The layer of sediments or sedimentary rocks bounded above and below by more or less well-defined bedding surfaces. The smallest, formal lithostratigraphic unit of sedimentary rocks. The designation of a bed or a unit of beds as a formally named lithostratigraphic unit generally should be limited to certain distinctive beds whose recognition is particularly useful. Coal beds, oil sands, and other layers of economic importance commonly are named, but such units and their names usually are not a part of formal stratigraphic nomenclature. Compare - formation. GG

bedded - Formed, arranged, or deposited in layers or beds, or made up of or occurring in the form of beds; especially said of a layered sedimentary rock, deposit, or formation. GG

bedding plane – A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It often marks a change in the circumstances of deposition, and may show a parting, a color difference, a change in particle size, or various combinations. A term commonly applied to any bedding surface even when conspicuously bent or deformed by folding. SW & GG

bedrock - A general term for the solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface. Compare - regolith, residuum. GG

bench - (not preferred) refer to structural bench.

berm - [beach] A low, impermanent, nearly horizontal or landward-sloping shelf, ledge, or narrow terrace on the backshore of a beach, formed of material thrown up and deposited by storm waves; it is generally bounded on one side or the other by a beach ridge or beach scarp. Some beaches have no berms, others have one or several. GG

beveled base – The lower portion of a canyon wall or escarpment marked by a sharp reduction in slope gradient from the precipitous cliff above, and characteristically composed of thinly mantled colluvium (e.g. < 1 m) and / or carapaced with a thin surficial mantle of large rock fragments from above, which overly residuum of less resistant rock (e.g., shale) whose thin strata intermittently outcrop at the surface; a zone of erosion and transport common in the canyonlands of the semi-arid, southwestern USA. Compare – talus slope. SW

beveled cut – A bank or slope portion of a cut excavated into unconsolidated material (regolith) or bedrock as in a roadcut, whose slope gradient has been mechanically reduced to a subdued angle (e.g. to < 33 %) to increase slope stability, reduce erosion, or to facilitate revegetation. Compare – cut, cutbank, roadcut. SW

blind valley - A valley, commonly in karst, that ends abruptly downstream at the point at which its stream disappears underground. GG

block [volcanic] - A pyroclast that was ejected in a solid state; it has a diameter greater than 64 mm. Compare - bomb, cinder, lapilli, tephra. GG

block field - A thin accumulation of stone blocks, typically angular, with only coarse fragments in the upper part, over solid or weathered bedrock, colluvium, or alluvium, without a cliff or ledge above as an apparent source. Block fields occur on high mountain slopes above tree-line, or in polar or paleo-periglacial regions; they are most extensive along slopes parallel to the contour; and they generally occur on slopes of less than 5%. Synonym - felsenmeer. Compare - block stream, talus slope, scree slope. GG

block glide [mass movement] – The process, associated sediments (block glide deposit) or resultant landform characterized by a slow type of slide, in which largely intact units (blocks) of rock or soil slide downslope along a relatively planar surface, such as a bedding plane, without any significant distortion of the original mass; a type of translational rock slide. Compare – rotational landslide, debris slide, lateral spread, landslide. SW & DV

block lava - Lava having a surface of angular blocks; it is similar to `a`a lava but the fragments are larger and more regular in shape, somewhat smoother, and less vesicular. Compare – `a`a lava, pahoehoe lava, pillow lava. GG

block lava flow – A lava flow dominated by block lava. Compare –`a`a lava flow, pahoehoe lava flow, pillow lava flow. SW

block stream - An accumulation of boulders or angular blocks, with no fine sizes in the upper part, overlying solid or weathered bedrock, colluvium, or alluvium, and lying below a cliff or ledge from which coarse fragments originate. Block streams usually occur at the heads of ravines as narrow bodies that are more extensive downslope than along the slope. They may exist on any slope angle, but ordinarily not steeper than 90 percent slope (approx. 40 degrees). Compare - block field. GG

blowout – A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand, loose soil, or where protective vegetation is disturbed or destroyed; the adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Commonly small, some blowouts may be large (kilometers in diameter). Compare – deflation basin. GG

blue rock [volcanic] – (colloquial – Hawaii) The very dense (e.g. 2.75 g/cc), extremely hard and massive, nominally vesicular lava that commonly forms the inner core of an `a`a lava flow. SW

bluff - (a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; ex. a river bluff. (b) (not preferred) use cliff. Any cliff with a steep, broad face. GG

bog - Waterlogged, spongy ground, consisting primarily of mosses, containing acidic, decaying vegetation such as sphagnum, sedges, and heaths, that may develop into peat. Compare - fen, marsh, swamp. GG

bolson - (colloquial: western USA.) A landscape term for an internally drained (closed) intermontane basin into which drainages from surrounding mountains converge inward toward a central depression. Bolsons are often tectonically depressed areas and, according to Peterson, include alluvial flat, alluvial plain, beach plain, barrier beach, lake plain, sand sheets, dunes, and playa. The piedmont slope includes slopes of erosional origin adjoining the mountain front (pediments) and complex construction surfaces (fans). A semi-bolson is an externally drained (open) bolson. Synonym - intermontane basin. GG and FFP.

bomb [volcanic] - A pyroclast > 64 mm in at least one dimension that was ejected while still viscous and solidified into it's rounded form in flight. Compare - block, cinder, lapilli, tephra. GG

borrow pit – An excavated area from which earthy material has been removed typically for construction purposes offsite; also called barrow pit. GG

bottomland - (not recommended) use flood plain. An obsolete, informal term loosely applied to varying portions of a flood plain. SW

boulder field - (not recommended) use block stream. Compare - block field.

bowl [gilgai] – A cup-or trough- shaped subsurface feature centered under and surrounding the depressional component (micro-low) of gilgai, commonly 3 - 5 m across and 1.5 to 3 m thick, containing numerous slickensides (oblique slip / shear faces) within it and bounded along its base by master slickensides. It is composed of turbated material associated with soils containing substantial amounts of smectitic clays (e.g. Vertisols). Its morphology is distinct from that found in adjacent micro-highs (chimney); underlying substratum material and morphology is not preserved within the bowl. Compare – chimney [gilgai], intermediate position [gilgai], gilgai. SW

box canyon – a) A narrow gorge or canyon containing an intermittent stream following a zigzag course, characterized by high, steep rock walls and typically closed upstream by a similar wall, giving the impression, as viewed from its bottom, of being surrounded or "boxed in" by almost vertical walls. b) A steep-walled canyon heading against a cliff a dead-end canyon. GG

braided channel - (not recommended) use braided stream.

braided stream - A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around inter-channel bars, resembling (in plan view) the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high **bed load**, non-cohesive bank material, and a steep gradient. At a given bank-full discharge, braided streams have steeper slopes and shallower, broader, and less stable channel cross sections than meandering streams. Compare - meandering channel, flood-plain landforms. HP

break - (slopes) An abrupt change or inflection in a slope or profile (as in "a break in slope"). Compare - knickpoint, shoulder, escarpment. (geomorphology) A marked variation of topography, or a tract of land distinct from adjacent land, or an irregular or rough piece of ground. Compare - breaks. GG

breaks - (colloquial: western USA) A landscape or large tract of steep, rough or broken land dissected by ravines and gullies and marks a sudden change in topography as from an elevated plain to lower hilly terrain, or a line of irregular cliffs at the edge of a mesa or a river (e.g., the Missouri River breaks). SW & GG

breccia - A coarse-grained, clastic rock composed of angular rock fragments (larger than 2 mm) commonly bonded by a mineral cement in a finer-grained matrix of varying composition and origin. The consolidated equivalent of rubble. Compare - conglomerate. GSST

broad interstream divide – (colloquial: southeastern USA) A type of very wide, low gradient (level to nearly level) interfluve that lacks a well developed drainage network such that large portions of the local upland lack stream channels or other drainageways; extensive in lower coastal plains and some lake plains, till plains and alluvial plain remnants. Compare – interfluve. SW & RD

brook [streams] – (not preferred, refer to ephemeral stream) Generally a very small, ephemeral stream, especially one that issues from a spring or seep and conducts less water volume and over shorter distances than a creek. Compare –intermittent stream. GG

burial mound – A small human-made hill, composed of debris accumulated during successive occupations of the site, or of earth heaped up to mark a burial site; also called mound. GG

buried - (adjective) Landforms, geomorphic surfaces, or paleosols covered by younger sediments (e.g. eolian, glacial, and alluvial). Compare - exhumed, relict. HP

buried soil - Soil covered by an alluvial, loessal, or other earthy mantle of more recent material, typically to depths exceeding 50 cm; recent surface deposits < 50 cm thick are generally considered as part of the ground soil. Compare - ground soil, exhumed, relict,. GSST & ST

butte - An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments, commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks. Compare - mesa, plateau, cuesta. HP & GG

caldera - A large, more or less circular depression, formed by explosion and/or collapse, which surrounds a volcanic vent or vents, and whose diameter is many times greater than that of the included vent, or vents. Compare - crater. GG

caliche - A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in non-indurated forms to very strong in types that are indurated. Other minerals (carbonates, silicate, sulfate) may be present as accessory cements. Most petrocalcic and some calcic horizons are caliche. HP

canyon - A long, deep, narrow, very steep-sided valley cut primarily in bedrock with high and precipitous walls in an area of high local relief (e.g., mountain or high plateau terrain), often with a perennial stream at the bottom; similar to but larger than a gorge. Compare – gorge, box canyon, slot canyon. SW, HP & GG

canyon bench – One of a series of relatively narrow, flat landforms occurring along a canyon wall and caused by differential erosion of alternating strong and weak horizontal strata; a type of structural bench. GG

canyonlands – A deeply and extensively dissected landscape composed predominantly of relatively narrow, steep-walled valleys with small flood plains or valley floors; commonly with considerable outcrops of hard bedrock on steep slopes, ledges, or cliffs, and with broader summits or interfluves than found in badlands. Side slopes exhibit extensive erosion, active back-wearing, and relatively sparse vegetation. SW

caprock – a) A hard rock layer, usually sandstone, lava or in arid environments, limestone, that lies above shale or other less resistant bedrock or sediments; specifically a rock layer that forms relatively level, resistant topmost strata that holds up hills, ridges, mesas, etc., and commonly forms cliffs or escarpments. Also spelled cap rock. SW & GG b) A hard rock layer, usually sandstone, over-lying the shale above a coal bed. Also spelled cap rock. GG

captured stream - A stream whose course has been diverted into the channel of another stream by natural processes. GG

Carolina Bay - Any of various shallow, often oval or elliptical, generally marshy, closed depressions in the Atlantic coastal plain (from southern New Jersey to northeastern Florida, especially developed in the Carolinas) which share an approximately parallel orientation of their long axes. They range from about 100 meters to many kilometers in length, are rich in humus, and under native conditions contain trees and shrubs different from those of the surrounding areas. Also called Grady ponds (colloquial: Georgia and Alabama) and Delmarva Bays (colloquial: Maryland). Compare - pocosin. GG

cat clay - (not recommended - obsolete) Wet, clay dominated soils containing ferrous sulfide which become highly acidic when drained. GSST

catena - [as used in USA] A sequence of soils across a landscape, of about the same age, derived from similar parent material, and occurring under similar climatic conditions, but have different characteristics due to variations in relief and in drainage. GSST

catsteps - (not preferred, refer to terracettes). A terracette; especially one produced by slumping of loess deposits as in western Iowa. GG

centripetal drainage pattern – A drainage pattern in which the streams converge inward toward a central depression; generally indicative of a structural basin, volcanic crater, caldera, breached dome, bolson, or the end of an eroded anticline or syncline. SW, GG , WA

channel - (a) [stream] The hollow bed where a natural body of surface water flows or may flow. The deepest or central part of the bed of a stream, containing the main current and occupied more or less continuously by water. (b) (colloquial: western U.S.A.) The bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium. Channels may be enclosed by banks or splayed across and slightly mounded above a fan surface and include bars and mounds of cobbles and stones. (c) [Microfeature] Small, trough-like, arcuate or sinuous channels separated by small bars or ridges, caused by fluvial processes; common to flood plains and young alluvial terraces; a constituent part of *bar and channel* topography. GG, FFP, & SW.

chenier - A long, narrow, vegetated marine beach ridge or sandy hummock, 1 to 6 m high, forming roughly parallel to a prograding shoreline seaward of marsh and mud-flat deposits, enclosed on the seaward side by fine-grained sediments, and resting on foreshore or mud-flat deposits. It is well drained, often supporting trees on higher areas. Widths range from 45 - 450 m and lengths may exceed several tens of kilometers. GG

chenier plain - A mud-rich strand plain, occupied by cheniers and intervening mud-flats with marsh and swamp vegetation. Compare - chenier, strand plain. GG

chert - A hard, extremely dense or compact, dull to semivitreous, cryptocrystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz less than about 30 mm in diameter; it may contain amorphous silica (opal). It sometimes contains impurities such as calcite, iron oxide, or the remains of siliceous and other organisms. It has a tough, splintery to conchoidal fracture and may be white or variously colored gray, green, blue, pink, red, yellow, brown, and black. Chert occurs principally as nodular or concretionary segregations in limestones and dolomites. GG

chimney [gilgai] – A subsurface feature that forms a crude cone or wave-crest structure centered under a micro-high (e.g. a low mound or rim) and extending at least part-way under adjacent intermediate positions, composed of substratum material that appears to upwell and reaches close to the surface. A chimney is commonly bounded by master slickensides in the subsoil with maximum angles of dip reaching 60 - 75 degrees under the micro-high. Its morphology is distinct from the soil solum of the adjacent micro-lows (e.g. lighter colored and more alkaline and contain carbonate or gypsum concretions absent under micro-lows). Compare – puff [gilgai], bowl [gilgai], intermediate position [gilgai], gilgai. SW

chimney and bowl topography – (not recommended; use gilgai).

cinder cone - A conical hill formed by the accumulation of cinders and other pyroclastics, normally basaltic or andesitic composition. Slopes generally exceed 20 percent. GG

cinders - Uncemented vitric, vesicular, pyroclastic material, more than 2.0 mm in at least one dimension, with an apparent specific gravity (including vesicles) of more than 1.0 and less than 2.0. Compare - ash [volcanic], block [volcanic], lapilli, scoria, tephra. KST

circle - A form of patterned ground whose horizontal mesh is dominantly circular. Compare - Nonsorted circle, patterned ground. GG

circular gilgai – A type of gilgai dominated by circular closed depressions (micro-lows) separated by low mounds (micro-highs); the prevailing type of gilgai on relatively level terrain (slopes < 3 %). Distance from micro-high to the center of an adjacent micro-low is generally 4 – 8 m. Compare – elliptical gilgai, linear gilgai, gilgai. SW

cirque – A steep-walled, half bowl-like recess or hollow, crescent-shaped or semicircular in plan, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain, and produced by the erosive activity of a mountain glacier. It often contains a small round lake (tarn). Compare – cirque floor, cirque platform, cirque wall. SW & GG.

cirque floor – The comparatively level bottom of a cirque, thinly mantled with till and consisting of glacially-scoured knolls and hillocks separated by depressions, flat areas and small lakes (tarn); commonly it is bounded by a slightly elevated rock lip at its exit. SW & HD

cirque headwall – The glacially-scoured, steep and arcuate side or wall of a cirque, dominated by rock-outcrops, rubble, and colluvium. Compare – headwall. SW & HD

cirque platform – A relatively level or bench-like surface formed by the coalescence of several cirques. GG & SW

cirque wall – (not preferred) refer to cirque headwall.

clast - An individual constituent, grain, or fragment of sediment or rock, produced by the mechanical weathering (disintegration) of a larger rock mass. HP

clastic - (adjective) Pertaining to rock or sediment composed mainly of fragments derived from preexisting rocks or minerals and moved from their place of origin. The term indicates sediment sources that are both within and outside the depositional basin. Compare - detritus, epiclastic, pyroclastic, volcaniclastic. GG

claypan - A dense, compact, slowly permeable layer in the subsoil, with a much higher clay content than overlying materials from which it is separated by a sharply defined boundary. Claypans are usually hard when dry, and plastic and sticky when wet. GSST

cliff - Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice. Compare – bluff, beveled base. GG

climbing dune – A dune formed by the piling-up of sand by wind against a cliff or mountain slope; very common in arid regions with substantial local relief and strong, prevailing winds. Compare - sand ramp. GG & SW

closed depression – A generic name for any enclosed area that has no surface drainage outlet and from which water escapes only by evaporation or subsurface drainage; an area of lower ground indicated on a topographic map by a hachured contour line forming a closed loop. Compare – open basin. SW & GG

coalescent fan piedmont - (not preferred) refer to fan piedmont. HP

coastal plain - A low, generally broad plain that has as its margin an oceanic shore and its strata horizontal or gently sloping toward the water, and generally represents a strip of recently prograded or emerged sea floor; e.g. the coastal plain of the southeastern U.S. which extends for 3000 km from New Jersey to Texas. GG '87

coastal marl – An earthy, unconsolidated deposit of gray to buff-colored mud of low bulk density (dry) composed primarily of very fine, almost pure calcium carbonate formed in subaqueous settings that span freshwater lacustrine conditions (e.g. Florida Everglades) to saline intertidal settings (e.g. Florida Keys) formed by the chemical action of algal mats and organic detritus (periphyton); other marl varieties associated with different environments (e.g. freshwater marl, glauconitic marl) also occur. Coastal marl can be quite pure or it can be finely disseminated throughout living root mats (e.g. mangrove roots) and / or organic soil layers. Compare – marl, freshwater marl. SW

cockpit – A crudely star-shaped, closed depression (i.e. large sinkhole) in tropical karst having an inverted conical or slightly concave floor, with an irregular or serrate perimeter formed by subsidiary solution channels and corridors into adjacent hills, and surrounded by residual hills with steep, concave side slopes; the dominant type of closed depression in cockpit karst. Compare – sinkhole, kegel karst. SW, WW & GG

cockpit karst – A karst landscape dominated by subsurface drainage and serrate or star-shaped depressions (cockpits) that range widely in size and density but typically are considerably larger than sinkholes (dolines), and are separated by intermediate residual hills with concave side slopes; a common type of tropical karst (e.g. Jamaica). Compare – kegel karst, karst. SW & WW

col - A high, narrow, sharp-edged pass or saddle through a divide or between two adjacent peaks in a mountain range; especially a deep pass formed by the headward erosion and intersection of two cirques. Compare - gap, pass, saddle. GG

collapsed ice-floored lakebed - A lakebed formed in a lake on glacial ice and subsequently "let down" or collapsed by the melting of underlying ice, resulting in contortion or folding of the lacustrine sediment and sedimentary structures. These modified or distorted lacustrine sediments cap present-day topographic highs and generally lie at elevations higher than the surrounding disintegration moraine. Compare - collapsed lake plain, collapsed ice-walled lakebed. SW & CF

collapsed ice-walled lakebed - A lakebed that formed in a lake bounded by stagnant ice, but floored by solid ground, usually till. Collapse features are limited to the lakebed margins. Presently, these materials and sedimentary structures generally occur as roughly circular-shaped hills of till capped by lacustrine sediments, generally at elevations higher than surrounding disintegration moraine. Compare - collapsed ice-floored lakebed, collapsed lake plain. SW & CF

collapsed lake plain - A lake plain formed on, and bounded by, glacial ice and subsequently "let down" or collapsed by the melting of underlying ice resulting in contortion or folding of the sediments and sedimentary structures. Lacustrine sediments cap present topography. Compare - lake plain. SW & CF

collapsed outwash plain - An outwash plain which forms on glacial ice (inside the glacial margin), and is subsequently let down or collapsed when the underlying ice melts, resulting in contortion or folding of the sediments and sedimentary structures to the extent that little of the original plain or it's gradient remain.

Outwash sediments commonly cap present-day topography. Compare - collapsed lake plain, pitted outwash plain. SW & CF

collapse sinkhole – A type of sinkhole that is formed by collapse of a cave within the underlying soluble bedrock (e.g., limestone, gypsum, salt). Compare – solution sinkhole. SW, WW, & GG

colluvial - (adjective) Pertaining to material or processes associated with transportation and/or deposition by mass movement (direct gravitational action) and local, unconcentrated runoff (overland flow) on side slopes and/or at the base of slopes. Compare – alluvial, fluvial. HP

colluvial apron - A landform with a concave to planar surface composed of a thick wedge-shaped deposit of colluvium and/or slope alluvium that forms the base (footslope) of a bluff, escarpment or steep slope . Compare – beveled base. SW

colluvium - Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, unconcentrated runoff. Compare - alluvium, slope alluvium, scree, talus, mass movement. HP

competence - The ability of a current of water or wind to transport sediment, in terms of particle size rather than amount, measured as the diameter of the largest particle transported. It depends upon velocity: a small but swift current for example, may have greater competence than a larger but slower moving current. GG

complex landslide [mass movement] – A category of mass movement processes, associated sediments (complex landslide deposit) or resultant landforms characterized by a composite of several mass movement processes none of which dominates or leaves a prevailing landform. Numerous types of complex landslides can be specified by naming the constituent processes evident (e.g. a *complex earth spread – earth flow* landslide). Compare – fall, topple, slide, lateral spread, flow, landslide. SW & DV

compound sinkhole – (not preferred) refer to karst valley.

cone karst – A variety of kegel karst topography, common in the tropics (e.g. Puerto Rico, Pacific Basin Islands) characterized by steep-sided, cone-shaped residual hills and ridges separated by star-shaped depressions, broader valleys, or lagoons. These hills and ridges have steep, convex side slopes and rounded tops that are dissected into secondary karst surfaces with shafts and various forms of karren microfeatures. Compare – karst cone, cockpit karst, fluviokarst, sinkhole karst, tower karst. SW & GG, WW

conformity - The mutual and undisturbed relationship between adjacent sedimentary strata that have been deposited in orderly sequence with little or no evidence of time lapses; true stratigraphic continuity in the sequence of beds without evidence that the lower beds were folded, tilted, or eroded before the higher beds were deposited. Compare – unconformity. GG

congelifraction - (not preferred) refer to frost shattering.

congeliturbate - (not recommended) use cryoturbate.

congeliturbation - (not recommended) use cryoturbation.

conglomerate - A coarse-grained, clastic sedimentary rock composed of rounded to subangular rock fragments larger than 2 mm, commonly with a matrix of sand and finer material; cements include silica, calcium carbonate, and iron oxides. The consolidated equivalent of gravel. Compare - breccia. HP

conservation terrace – An earthen embankment constructed across a slope for conducting water from above at a regulated flow to prevent accelerated erosion and to conserve water. Compare – hillslope terrace. SW & GSST

constructional [geomorphology] - (adjective) Said of a landform that owes its origin, form, position, or general character to depositional (aggradational) processes, such as the accumulation of sediment (e.g., alluvial fan, volcanic cone). Compare - aggradation, destructional, erosional. GG

continuous permafrost - Permafrost occurring everywhere beneath the exposed land surface throughout a geographic region. Compare - discontinuous permafrost, sporadic permafrost. NRC

continental glacier – A glacier of considerable thickness completely covering a large part of a continent or an area of at least 50,000 square km, obscuring the underlying surface, such as the ice sheets covering Antarctica or Greenland. Continental glaciers occupied northern portions of the coterminous USA and Alaska in the past (e.g., Pleistocene) and usage commonly implies former continental glacier conditions. Compare – alpine glacier. SW & GG

coppice mound (also called coppice dune) - (not recommended: obsolete) use shrub-coppice dune.

coprogenous earth [Soil Taxonomy] - A type of limnic layer (sedimentary peat) composed predominantly of fecal material derived from aquatic animals. ST

coprogenic material [soil survey] - The remains of fish excreta and similar materials that occur in some organic soils. GSST

corda – Small, tightly bunched, parallel ridges or corrugations of lava, commonly ≤ 1 m in amplitude (high) and < 3 m in period (wide) on the surface of corded pahoehoe lava (ropy lava). SW & GS

corrosion [geomorphology] - A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation. GG

coulee - (colloquial: northwest USA, and ND) A dry or intermittent stream valley or wash with an underfit stream, especially a long, steep-walled gorge representing a Pleistocene overflow channel that carried meltwater from an ice sheet; e.g. the Grand Coulee in Washington State. HP

country rock - A general term for the non-igneous rock surrounding an igneous intrusion. GG

cove [coast] – a) [water] A small, narrow sheltered bay, inlet, creek or recess in an estuary, often inside a larger embayment. Compare – lagoon bottom. SSS & GG b) A small, often circular, wave-cut indentation in a cliff; it usually has a restricted or narrow entrance. c) A fairly broad, looped embayment in a lake shoreline. d) A shallow tidal river, or the backwater near the mouth of a tidal river. Compare - estuary. GG

cove [geom.] – a) A walled and rounded or cirque-like opening at the head of a small steep valley. b) (colloquial - southern Appalachians, USA) A smooth-floored, somewhat oval-shaped "valley" sheltered by hills or mountains; e.g., Cades Cove in eastern Tennessee. GG

coral island – a) A relict coral reef that stands above sea level and surrounded by water (e.g. Florida Keys). Carbonate sands rich in coral and shell fragments generally mantle the underlying flat coral platform. b) An oceanic island formed from coral accumulations lying atop or fringing volcanic peaks or platforms. SW & GG

cradle and knoll topography – (not recommended) use tree-tip pit and mound topography.

crag and tail – An elongate hill or ridge of subglacially streamlined drift, having at the stoss end (up-ice) a steep, often precipitous face or knob of ice-smoothed, resistant bedrock (the "crag") obstructing the movement of the glacier, and at the lee end (down-ice) a tapering, streamlined, gentle slope (the "tail") of intact, weaker rock and / or drift protected by the crag; also called lee-side cone. Compare – drumlin, drumlinoid ridge, flute, stoss and lee. GG, SW, & GM

crater [volcanic] - A basin-like, rimmed structure, usually at the summit of a volcanic cone. It may be formed by collapse, by an explosive eruption or by the gradual accumulation of pyroclastic material into a surrounding rim. Compare - caldera. GG

craton - A part of the earth's crust that has attained stability, and has been minimally deformed for a prolonged period. The term is now restricted to continental areas of largely Precambrian rocks. GG

creek [streams] – (not preferred, refer to intermittent stream) A general term used throughout the USA (except New England), Canada, and Australia for a small, intermittent stream that is larger than a brook but smaller than a river. GG

creep [mass movement] - The process, associated sediments (creep deposit) or resultant landform or mantle characterized by a very slow type of earthflow dominated by the gradual movement of unconsolidated earthy material down slopes, driven primarily by gravity, but facilitated by saturation with water and by alternate freezing and thawing; sometimes redundantly called soil creep. Compare - mudflow, flow, landslide, solifluction. SW

crest - (a) The commonly linear, narrow top of a ridge, hill, or mountain. It is appropriately applied to elevated areas where retreating backslopes are converging such that these high areas are almost exclusively composed of convex shoulders; (b) (not preferred) Sometimes used as an alternative for the hillslope component *summit*. Compare - summit (*part b*), saddle. FFP & SW

crest [geomorphology] – A geomorphic component of hills consisting of the convex slopes (perpendicular to the contour) that form the narrow, roughly linear top area of a hill, ridge, or other upland where shoulders have converged to the extent that little or no summit remains; dominated by erosion, slope wash and mass movement processes and sediments (e.g., slope alluvium, creep). Commonly, soils on crests are more similar to those on side slopes than to soils on adjacent interfluves. Compare – interfluve, head slope, side slope, nose slope. SW

crevasse [geomorphology] - (a) A wide breach or crack in the bank of a river or canal; especially one in a natural levee or an artificial bank of the lower Mississippi River. Compare - flood-plain splay, avulsion. (b) A wide, deep break or fissure in the Earth after an earthquake. [glaciology] A deep, nearly vertical fissure, crack, or rift in a glacier or other mass of land ice. GG

crevasse filling - A short, straight ridge of stratified sand and gravel believed to have been deposited in a crevasse of a wasting glacier and left standing after the ice melted; a variety of kame. May also occur as long, sinuous ridges and linear complexes of till or drift. GG

crevasse splay - (not recommended) use flood-plain splay. Compare - crevasse.

cross-bedding - (a) Cross-stratification in which the cross-beds are more than 1 cm in thickness. (b) A cross-bedded structure; a cross-bed. Compare - cross-lamination. GG

cross-lamination - (a) Cross-stratification characterized by cross-beds that are less than 1 cm in thickness. (b) A cross-laminated structure; a cross-lamina. Compare - cross-bedding. GG

cross-stratification - Arrangement of strata inclined at an angle to the main stratification. This is a general term having two subdivisions; cross-bedding, in which the cross-strata are thicker than 1 cm, and cross-lamination, in which they are thinner than 1 cm. A single group of related cross-strata is a set and a group of similar, related sets is a coset. GG

cryoplanation - The reduction and modification of a land surface by processes associated with intensive frost action, such as solifluction, supplemented by the erosive and transport actions of running water, moving ice, and other agents. GG

cryoturbate - A mass of soil or other unconsolidated earthy material moved or disturbed by frost action, and usually coarser than the underlying material; especially a rubbly deposit formed by solifluction. GG

cryoturbation - A collective term used to describe all soil movements due to frost action, characterized by folded, broken and dislocated beds and lenses of unconsolidated deposits. Compare - pedoturbation. NRC

cryptogamic crust - A type of microbiotic crust consisting of a thin, biotic layer at the ground surface composed predominantly of cryptogams (i.e. algae, lichen, mosses, lichens and liverworts); most commonly found in semiarid or arid environments. Compare - microbiotic crust. SW & SS

cuesta - An asymmetric ridge capped by resistant rock layers of slight to moderate dip, commonly less than 10^{o} (or approximately < 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope), that roughly parallels the inclined beds, and on the other side has a relatively short and steep or cliff-like slope (scarp) that cuts through the tilted rocks. Compare – hogback, homoclinal ridge, mesa, dipslope, scarp slope, cuesta valley. SW & HP

cuesta valley - An asymmetrical depression adjacent to cuestas which lies parallel to the strike of the underlying, gently dipping strata; a type of strike valley. It's formed by the differential erosion of weaker strata interbedded with, or stratigraphically adjacent to more resistant bedrock. It may or may not contain a local drainage network but commonly lies above and is not connected to the regional drainage system. Compare - cuesta, strike valley. SW

cut [geology] – A passage, incision, or space from which material has been excavated, such as a road cut or a railroad cut. GG

cut and fill – A *process* of leveling, whereby material eroded from one place by waves, currents, streams, or winds is deposited nearby until the surfaces of erosion and deposition are continuous and uniformly graded; especially lateral erosion on the concave banks of a meandering stream accompanied by deposition within its loops. Compare – flood-plain step, stream terrace, terrace. GG

cutbank – a) A slope or wall portion of a cut excavated into unconsolidated material (regolith) or bedrock, as in a borrow pit. It may stand nearly vertical resulting from collapse as the base is undercut during excavation or by erosion, or it may be reduced by subsequent erosion to a more subdued angle by slope wash. Compare – cut, beveled cut, roadcut. SW b) (not preferred – refer to escarpment, meander scar, bluff) [colloquial – western USA] – A steep, bare slope formed by lateral migration of a stream. GG

cutoff [streams] - The new and relatively short channel formed when a stream cuts through a narrow strip of land and thereby shortens the length of its channel. GG

cutter [karst] – A dissolution groove or trench formed along vertical bedrock fractures beneath soil and usually buried beneath regolith with little or no ground surface expression, commonly wider than a solution fissure (widths commonly range from 0.5 to 3 meters) and tapering down to a crack or a bedrock floored trench; also called grike (not preferred), or subsurface karren. Compare – karren, solution fissure, solution corridor. SW & WW

cyclothem - A series of beds deposited during a single sedimentary cycle of the type that prevailed during the Pennsylvanian Period. It is an informal, lithostratigraphic unit equivalent to "formation". Cyclothems are typically associated with unstable shelf or interior basin conditions in which alternate marine transgression and regressions occur. The term has also been applied to rocks of different ages and of different lithologies from the Pennsylvanian cyclothems. Compare - rhythmite. GG

dead-ice - (not recommended) use stagnant ice.

dead-ice moraine - (not recommended) use disintegration moraine.

debris - Any surficial accumulation of loose material detached from rock masses by chemical and mechanical means, as by decay and disintegration. It consists of rock clastic material of any size and sometimes organic matter. GG

debris avalanche [mass movement] – The process, associated sediments (debris avalanche deposit) or resultant landform characterized by a very rapid to extremely rapid type of *flow* dominated by the sudden downslope movement of incoherent, unsorted mixtures of soil and weathered bedrock which, although comparatively dry, behave much as a viscous fluid when moving. Compare – debris flow, rock fragment flow, debris avalanche, earthflow, landslide. SW &

debris fall [mass movement] – The process, associated sediments (debris fall deposit) or resultant landform characterized by a rapid type of *fall* involving the relatively free, downslope movement or collapse of detached, unconsolidated material which falls freely through the air (lacks an underlying slip face); sediments have substantial proportions of both fine earth and coarse fragments; common along undercut stream banks. Compare – rock fall, soil fall, landslide. SW

debris flow [mass movement] - The process, associated sediments (debris flow deposit) or resultant landform characterized by a very rapid type of *flow* dominated by a sudden downslope movement of a mass of rock, soil, and mud (more than 50% of the particles are > 2mm), and whether saturated or comparatively dry, behaves much as a viscous fluid when moving. Compare – lahar, mudflow, landslide. SW

debris slide [mass movement] - The process, associated sediments (debris slide deposit) or resultant landform characterized by a rapid type of *slide*, composed of comparatively dry and largely unconsolidated earthy material which slides or rolls downslope (does not exhibit backward rotation) and resulting in an irregular, hummocky deposit somewhat resembling a moraine. Compare – rotational landslide, block glide, lateral spread, landslide. SW & GG

debris spread [mass movement] – The process, associated sediments (debris spread deposit) or resultant landforms characterized by a very rapid type of *spread* dominated by lateral movement in a soil and rock mass resulting from liquefaction or plastic flow of underlying materials that may be extruded out between intact units; sediments have substantial proportions of both fine earth and coarse fragments. Compare – earth spread, rock spread, landslide. SW & DV

debris topple [mass movement] – The process, associated sediments (debris topple deposit) or resultant landform characterized by a localized, very rapid type of *topple* in which large blocks of soil and rock material literally fall over, rotating outward over a low pivot point; sediments have substantial proportions of both fine earth and coarse fragments. Portions of the original material may remain intact, although reoriented, within the resulting debris pile. Compare – earth topple, rock topple, landslide. SW

deflation - The sorting out, lifting and removal of loose, dry, fine-grained soil particles (clays, silts, and fine sands) by the turbulent eddy action of the wind; a form of wind erosion. GG & GSST

deflation basin - A topographic basin excavated and maintained by wind erosion which removes unconsolidated material and commonly leaves a rim of resistant material surrounding the depression. Unlike a blowout, a deflation basin does not include adjacent deposits derived from the basin. Compare - blowout. GG

deflation flat - (colloquial – US Gulf Coast) A series of low ridges and troughs on an essentially flat surface on barrier islands formed by dune field migration during alternating wet and dry periods; a type of interdune. Troughs are eroded down to the wet sand level during drought periods (dune slack), while the ridges are stabilized by vegetation that invades the edge of dune fields during wet periods. Compare – blowout, deflation basin. HF

degradation [geomorphology] - The wearing down or away, and the general lowering of the land surface by natural processes of weathering and erosion (e.g., the deepening by a stream of its channel) and may infer the process of transportation of sediment. Compare - destructional. GG

Delmarva Bay – see Carolina Bay

delta - A body of alluvium, nearly flat and fan-shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, usually a sea or lake. HP

delta plain - The level or nearly level surface composing the land-ward part of a large delta; strictly, a flood plain characterized by repeated channel bifurcation and divergence, multiple distributary channels, and interdistributary flood basins. GG

dendritic drainage pattern - A common drainage pattern in which the tributaries join the gently curving mainstream at acute angles, resembling in plan view the branching habit of an oak or chestnut tree; it is produced where a consequent stream receives several tributaries which in turn are fed by smaller tributaries. It indicates streams flowing across horizontal rock strata and homogenous soil typified by the landforms of soft sedimentary rocks, volcanic tuff, old dissected coastal plains, or complex crystalline rocks offering uniform resistance to erosion. SW, WA, GG

deposit - Either consolidated or unconsolidated material of any type that has accumulated by natural processes or by human activity. SW
deposition - The laying down of any material by any agent such as wind, water, ice or by other natural processes. HP

depression - Any relatively sunken part of the Earth's surface; especially a low-lying area surrounded by higher ground. A closed depression has no natural outlet for surface drainage (e.g. a sinkhole). An open depression has a natural outlet for surface drainage. Compare – closed depression, open depression. GG

deranged drainage pattern – A distinctively disordered drainage pattern of nonintegrated streams which indicates a complete lack of underlying structural and bedrock control, resulting from a relatively young landscape having a flat or undulating topographic surface and a high water table. It is characterized by relatively few, irregular streams with few, short tributaries, that flow into and out of depressions containing swamps, bogs, marshes, ponds, or lakes; interstream areas are swampy. Regional streams may meander through the area but do not influence its drainage. These drainage patterns commonly occur on young, thick till plains, end moraines, flood plains, and coastal plains. SW, WA

desert pavement - A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments, mantling a desert surface. It is formed where wind action and sheetwash have removed all smaller particles or where coarse fragments have migrated upward through sediments to the surface. It usually protects the underlying, finer-grained material from further deflation. Compare – erosion pavement, stone line. SW, GSST & GG

desert varnish - (not preferred) refer to rock varnish.

destructional [geomorphology] - (adjective) Said of a landform that owes its origin, form, position, or general character to the removal of material by erosion and weathering (degradation) processes resulting from the wearing-down or away of the land surface. Compare - constructional. GG

detritus [geology] - A collective term for rock and mineral coarse fragments occurring in sediments, that are detached or removed by mechanical means (e.g. disintegration, abrasion) and derived from pre-existing rocks and moved from their place of origin. Compare - clastic, epiclastic, pyroclastic. GG

diamict - (not preferred; refer to diamicton) A general term that includes both diamictite (coherent rock) and diamicton (unconsolidated sediments). GG

diamictite - A general term for any nonsorted or poorly sorted, noncalcareous, terrigenous sedimentary *rock* (e.g., pebbly mudstone) containing a wide range of particle sizes. Compare - diamicton. GG

diamicton - A generic term for any nonlithified, nonsorted or poorly sorted *sediment* that contains a wide range of particle sizes, such as coarse fragments contained within a fine earth matrix (e.g. till) and used when the genetic context of the sediment is uncertain. Compare - diamictite. SW & GG

diapir - A dome or anticlinal fold in which the overlying rocks or sediments have been ruptured by the squeezing-out of plastic core material. Diapirs in sedimentary strata usually contain cores of salt or shale; igneous intrusions may also show diapiric structure. GG

diatomaceous earth - A geologic deposit of fine, grayish, siliceous material composed chiefly or wholly of the remains of diatoms. It may occur as a powder or a rigid material. Also called diatomaceous materials. GSST

diatreme – A breccia-filled volcanic pipe that was formed by a gaseous explosion (e.g. hydrovolcanic eruption); commonly, but not exclusively associated with exposed throat or neck of maar, as in the Hopi Buttes area of Arizona. Compare – neck [volcanic]. SW & GG

dike [intrusive rocks] - A tabular igneous intrusion that cuts across the bedding or foliation of the country rock. Compare - sill. GG

dip – [soil survey] A geomorphic component (characteristic piece) of flat plains (e.g., lake plain, low coastal plain, low-relief till plain) consisting of a shallow and typically closed depression that tends to be an area of focused groundwater recharge but not a permanent water body and that lies slightly lower and is wetter than the adjacent talf, and favors the accumulation of fine sediments and organic materials. SW

dip - The maximum angle that a structural surface, (e.g. a bedding or fault plane) makes with the horizontal, measured perpendicular to the strike of the structure and in the vertical plane; used in combination with "dip" to describe the orientation of bedrock strata. SW & GG

dip slope - A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rocks; (i.e. the long, gently inclined surface of a cuesta). Compare - scarp slope. HP

discontinuity - [stratigraphy] Any interruption in sedimentation, whatever its cause or length, usually a manifestation of nondeposition and accompanying erosion; an unconformity. GG

discontinuous permafrost - Permafrost occurring in some areas beneath the exposed land surface throughout a geographic region where other areas are free of permafrost. Compare - continuous permafrost, sporadic permafrost. NRC

disintegration moraine - A drift topography characterized by chaotic mounds and pits, generally randomly oriented, developed in supraglacial drift by collapse and flow as the underlying stagnant ice melted. Slopes may be steep and unstable and there will be used and unused stream courses and lake depressions interspersed with the morainic ridges. Characteristically, there are numerous abrupt, lateral and vertical changes between unconsolidated materials of differing lithology. SJ & SW

distal [sedimentology] - (adjective) Said of a sedimentary deposit consisting of fine clastics and deposited farthest from the source area. Compare - proximal. GG

distributary [streams] - (a) A divergent stream flowing away from the main stream and not returning to it, as in a delta or on a flood plain. It may be produced by stream deposition choking the original channel. (b) One of the channels of a braided stream; a channel carrying the water of a stream distributary. GG

ditch - An open and usually unpaved (unlined), channel or trench excavated to convey water for drainage (removal) or irrigation (addition) to or from a landscape; smaller than a canal; some ditches are modified natural waterways. GG

divide - (a) The line of separation; (b) The summit area, or narrow tract of higher ground that constitutes the watershed boundary between two adjacent drainage basins; it divides the surface waters that flow naturally in one direction from those that flow in the opposite direction. Compare - interfluve GG

doline – (not preferred; refer to synonym "sinkhole")

doline karst – (not preferred) refer to sinkhole karst.

dolomite [mineral] - A common rock-forming rhombohedral carbonate mineral: $CaMg(CO_3)_2$. GG

dolomite [rock] -A carbonate sedimentary rock consisting chiefly (more than 50 percent by weight or by areal percentages under the microscope) of the mineral dolomite. GG

dolostone - (not recommended - use dolomite) An obsolete term proposed for the sedimentary rock called dolomite, in order to avoid confusion with the mineral of the same name. Compare - dolomite. GG

dome - (a) [structural geology] An uplift or anticlinal structure, either circular or elliptical in outline, in which the rocks dip gently away in all directions. A dome may be small (e.g. a salt dome) or many kilometers in diameter. (b) [geomorphology] A smoothly rounded landform of rock mass such as a rock-capped mountain summit, that roughly resembles the dome of a building. (e.g. the rounded granite peaks of Yosemite, CA). GG

double-bedding mound – Raised, linear mounds with subdued, convex slope cross-sections constructed by mounding and shaping spoil material dredged from adjacent drainage ditches and placed over natural soil. The mounds serve as preferred, better-drained bedding areas for managed timber plantations; common in the lower coastal plains of the Atlantic and Gulf coasts, USA. SW

drainage basin - A general term for a region or area bounded by a drainage divide and occupied by a drainage system. GG

drainage network - (not preferred) refer to drainage pattern.

drainage pattern - The configuration or arrangement, in plan view, of the stream courses in an area, including gullies or first-order areas of channelized flow, tributaries, and main streams. It is related to local geologic materials, geomorphologic features and geomorphic history of the area; major drainage pattern types include dendritic, trellis, artificial, etc. Also called drainage network. SW, GG, WA

drainageway - (a) A general term for a course or channel along which water moves in draining an area. GG; (b) [soil survey] a term restricted to relatively small, roughly linear or arcuate depressions that move concentrated water at some time, and either lack a defined channel (e.g. head slope, swale) or have a small, defined channel (e.g. low order streams). SW

drainhead complex – An irregular series of low, broad depressions that form the uppermost reaches of surface drainage networks in low relief / low gradient terrain such as coastal plains, and separated by slightly higher and drier areas (e.g. flatwoods). They characteristically lack defined stream channels but contribute surface water to the drainage system further downstream through a network of subtle topographic lows. SW

draw - A small, natural watercourse cut in unconsolidated materials, generally more open with a broader floor and more gently sloping sides than an arroyo, ravine or gulch, and whose present stream channel may appear inadequate to have cut the drainageway that it occupies. SW

dredged channel - A roughly linear, deep water area formed by a dredging operation for navigation purposes (after Wells et al., 1994; dredged hole). Compare – dredge-deposit shoal. SSS

dredge-deposit shoal - A subaqueous area, substantially shallower than the surrounding area that resulted from the deposition of materials from dredging and dumping (modified from Demas 1998). Compare – dredged channel, shoal. SSS

dredge spoils – Unconsolidated, randomly mixed sediments composed of rock, soil, and/or shell materials extracted and deposited during dredging and dumping activities. Dredge spoils lie unconformably upon natural, undisturbed soil or regolith and can form anthropogenic landforms (e.g. dredge spoil bank). SW

dredge spoil bank - A subaerial mound or ridge that permanently stands above the water composed of dredge spoils; randomly mixed sediments deposited during dredging and dumping. Compare – dredged channel, dredge-deposit shoal, filled marshland. SW

drift [glacial geology] - A general term applied to all mineral material (clay, silt, sand, gravel, boulders) transported by a glacier and deposited directly by or from the ice, or by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines, and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers. GG

dropstone - An oversized stone (compared to the matrix sediments) in laminated sediment that depresses the underlying laminae and can be covered by "draped laminae". Most dropstones originate through ice-rafting; another source is floating tree roots. Compare - erratic, ice-rafting. GG

drumlin - A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It usually has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longest axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition. Compare – drumlinoid ridge. SW, HP, & GG

drumlin field - Groups or clusters of closely spaced drumlins or drumlinoid ridges, distributed more or less en echelon, and commonly separated by small, marshy tracts or depressions (interdrumlins). SW

drumlinoid ridge – A rock drumlin or drift deposit whose form approaches but does not fully attain that of a classic drumlin, even though it seemingly results from similar processes of moving ice. Compare – drumlin, interdrumlin. SW & GG

dry wash - (not preferred - refer to wash). A dry, ephemeral stream channel, especially in semiarid regions which only moves water in response to intense, infrequent precipitation. Compare - arroyo. SW

dump – An area of smooth or uneven accumulations or piles of waste rock, earthy material, or general refuse that without major reclamation are incapable of supporting plants. Compare – sanitary landfill, fill. GSST

dune - A low mound, ridge, bank or hill of loose, windblown, subaerially deposited granular material (generally sand), either barren and capable of movement from place to place, or covered and stabilized with vegetation, but retaining its characteristic shape. (See barchan dune, parabolic dune, parna dune, shrub-coppice dune, seif dune, transverse dune). SW & GG

dune field – An assemblage of moving and/or stabilized dunes, together with sand plains, interdune areas, and the ponds, lakes, or swamps produced by the blocking of waterways by migrating dunes. See dune lake. SW & SSS

dune lake – (a) A lake occupying a deflation basin as in a blowout on a dune. (b) A lake occupying a basin formed by the blocking of a stream by sand dunes migrating along a shore (e.g. Moses lake, WA). GG

dune slack – A damp depression or trough between dunes in a dune field or dune ridges on a shore, caused by intersecting the capillary fringe of the local water table; a moist type of interdune. Compare – interdune, dune lake. SW & GG

dune traces – A series of linear to semi-concentric micro-ridges and intervening troughs, on the floor of a dune slack or interdune that were exposed by deflation or dune migration. The ridges are remnant bases of slip face lamina held together by soil moisture and /or cemented by evaporites. SW

earth dike - (not preferred) refer to levee (stream).

earth fall – see soil fall.

earthflow [mass movement] – The process, associated sediments (earthflow deposit) or resultant landforms characterized by slow to rapid types of flow dominated by downslope movement of soil, rock, and mud (more than 50% of the particles are < 2 mm), and whether saturated or comparatively dry, behaves as a viscous fluid when moving. Compare – debris flow (coarser, less fluid), mudflow (finer, more fluid). SW

earth hummock - A type of hummock consisting predominantly of a core of silty and clayey mineral soil and showing evidence of cryoturbation. Earth hummocks are a type of nonsorted circle. Compare - turf hummock, hummock [patterned ground], non-sorted circle, patterned ground. NRC

earth pillar - A tall, conical column of unconsolidated to semi-consolidated earth materials (e.g. clay till, or landslide debris) produced by differential erosion and usually capped by a flat, hard rock fragment that shields the underlying, softer material from erosion. It can measure up to 6-20 m in height, and its diameter is a function of the width of the protective boulder. Compare - hoodoo. GG

earth spread [mass movement] – The process, associated sediments (earth spread deposit) or resultant landforms characterized by a very rapid type of *spread* dominated by lateral movement in a soil mass resulting from liquefaction or plastic flow of underlying materials that may be extruded out between intact units. Compare – debris spread, rock spread, landslide. SW & DV

earth topple [mass movement] – The process, associated sediments (earth topple deposit) or resultant landform characterized by a localized, very rapid type of *topple* in which large blocks of soil material literally fall over, rotating outward over a low pivot point; sediments < 2 mm predominate. Portions of the original material may remain intact, although reoriented, within the resulting deposit. Compare –debris topple, rock topple, landslide. SW

elevation [survey] - The height of a point on the earth's surface relative to mean sea level (msl). Compare - relief. SW

elevated lake plain - (not preferred) refer to collapsed lake plain, collapsed ice-floored lakebed.

elliptical gilgai – A type of gilgai dominated by elliptical, closed and semi-closed depressions (micro-lows) separated by low mounds or ridges (micro-highs); the prevailing type of gilgai on mildly sloping terrain (slopes 3 – 8 %); as slope increases, basins become more eccentric and the occurrence of interconnected micro-lows increases. Compare – circular gilgai, linear gilgai, gilgai. SW

end moraine - A ridge-like accumulation that is being or was produced at the outer margin of an actively flowing glacier at any given time; a moraine that has been deposited at the outer or lower end of a valley glacier. Compare - terminal moraine, recessional moraine, ground moraine. GG

Eocene - The epoch of the Tertiary Period of geologic time (from 35.4 to 56.5 million years ago), immediately following the Paleocene epoch and preceding the Oligocene epoch; also corresponding (time-stratigraphic) "series" of earth materials. SW

eolian - Pertaining to material transported and deposited (eolian deposit) by the wind. Includes clastic materials such as dune sands, sand sheets, loess deposits, and clay (e.g. parna). HP

eolian deposit [soil survey] – Sand, silt or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess. Conventionally, primary volcanic deposits (e.g. tephra) are handled separately. Compare – loess, parna, beach sands. SW

eolian sands [soil survey] - Sand-sized, clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sand sheet. Compare - beach sands. SW

ephemeral stream – Generally a small stream, or upper reach of a stream, that flows only in direct response to precipitation. It receives no protracted water supply from melting snow or other sources and its channel is above the water table at all times. Compare – arroyo, intermittent stream, perennial stream. HP

epiclastic - Pertaining to any clastic rock or sediment other than pyroclastic. Constituent fragments are derived by weathering and erosion rather than by direct volcanic processes. Compare - pyroclastic, volcaniclastic, clastic, detritus. HP

eroded fan remnant – All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an *erosional fan remnant* (FFP). It consists primarily of a) eroded and highly dissected sides (*eroded fan-remnant sideslopes*) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan "summit" area best described as a tread. SW & FFP

eroded fan-remnant sideslope – A rough or broken margin of an *eroded fan remnant* highly dissected by ravines and gullies that can be just a fringe or make up a large part of an eroded alluvial fan; its bounding escarpments (risers), originally formed by inset channels, have become highly dissected and irregular such that terrace components (tread and riser) have been consumed or modified and replaced by hillslope positions and components (shoulder, backslope, footslope, etc.); sometimes referred to as *fan remnant sideslopes* (FFP). Compare – eroded fan remnant. SW & FFP

erosion - The wearing away of the land surface by running water, waves, or moving ice and wind, or by such processes as mass wasting and corrosion (solution and other chemical processes). The term "geologic erosion" refers to natural erosion processes occurring over long (geologic) time spans. "Accelerated erosion" generically refers to erosion in excess of what is presumed or estimated to be naturally occurring levels, and which is a direct result of human activities (e.g. cultivation, logging, etc.). SW & HP

erosional [geomorphology] - (adjective) Owing its origin, form, position or general character to degradational processes by water, wind, ice or gravity. Compare - constructional. HP

erosional outlier - (not preferred) refer to erosion remnant.

erosional pavement – see erosion pavement.

erosion pavement – A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion. Compare – desert pavement, stone line. SW, GSST, GG

erosion remnant - A topographic feature that remains or is left standing above the general land surface after erosion has reduced the surrounding area; e.g., a monadnock, a butte, or a stack. GG

erosion surface - A land surface shaped by the action of erosion, especially by running water. GG

erratic - A rock fragment carried by glacial ice, or by floating ice (ice-rafting), and subsequently deposited at some distance from the outcrop from which it was derived, and generally, though not necessarily, resting on bedrock or sediments of different lithology. Coarse fragments range in size from a pebble to a house-size block. GG

escarpment - A relatively continuous and steep slope or cliff produced by erosion or faulting and that topographically interrupts or breaks the general continuity of more gently sloping land surfaces . The term is most commonly applied to cliffs produced by differential erosion. Synonym: "scarp." SW & HP

esker - A long, narrow, sinuous and steep-sided ridge composed of irregularly stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier, and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers, and in height from 3 to 30 meters. Compare - kame, crevasse filling, glaciofluvial deposits, outwash. SW

estuarine deposit - Fine-grained sediments (very fine sand, silt and clay) of marine and fluvial origin commonly containing decomposed organic matter, laid down in the brackish waters of an estuary; characteristically finer sediments than deltaic deposits. Compare – fluviomarine deposit, lacustrine deposit, lagoonal deposit, marine deposit, overbank deposit. GG

estuarine subaqueous soils - Soils that form in sediment found in shallow-subtidal environments in protected estuarine coves, bays, inlets, and lagoons. Excluded from the definition of these soils are any areas "permanently covered by water too deep (typically greater than 2.5 m) for the growth of rooted plants". SSS

estuary - (a) A seaward end or the widened funnel-shaped tidal mouth of a river valley where fresh water comes into contact with seawater and where tidal effects are evident; e.g., a tidal river, or a partially enclosed coastal body of water where the tide meets the current of a stream. (b) A portion of an ocean or an arm of the sea affected by fresh water. (c) A drowned river mouth formed by the subsidence of land near the coast or by the drowning of the lower portion of a non-glacial valley due to the rise of sea level. Compare – lagoon. GG

everglades – (colloquial – southern USA) A large expanse of marshy land, covered mostly by grasses, e.g. the Florida Everglades. GG

exfoliation - The process by which concentric scales, plates, or shells of rock, from less than a centimeter to several meters in thickness, are successively spalled or stripped from the bare surface of a large rock mass. It often results in a rounded rock mass or dome-shaped hill. GG

exhumed - (adjective) Formerly buried landforms, geomorphic surfaces, or paleosols that have been re-exposed by erosion of the covering mantle. Compare - relict, buried, ground soil. HP

extramorainic - (not preferred) refer to extramorainal

extramorainal - (adjective) Said of deposits and phenomena occurring outside the area occupied by a glacier and it's lateral and end moraines. Compare - intramorainal. GG

extrusive - (adjective) Said of igneous rocks and sediments derived from deep-seated molten matter (magmas), deposited and cooled on the earth's surface (e.g. including lava flows and tephra deposits). Compare - intrusive, volcanic. HP

faceted spur - The inverted V-shaped end of a ridge that has been truncated or steeply beveled by steam erosion (e.g. meander scar or bluff), glacial truncation, or fault scarp displacement. Compare - spur. SW

facies [stratigraphy] - A distinctive group of characteristics that distinguish one group from another within a stratigraphic unit; the sum of all primary lithologic and paleontological characteristics of sediments or sedimentary rock that are used to infer its origin and environment; the general nature of appearance of sediments or sedimentary rock produced under a given set of conditions; e.g.: contrasting river-channel facies and overbank-flood-plain facies in alluvial valley fills. HP

fall [mass movement] - (a) A category of mass movement processes, associated sediments (fall deposit), or resultant landforms (e.g., rockfall, debris fall, soil fall) characterized by very rapid movement of a mass of rock or earth that travels mostly through the air by free fall, leaping, bounding, or rolling, with little or no interaction between one moving unit and another. Compare – topple, slide, lateral spread, flow, complex landslide, landslide. SW & DV; (b) The mass of material moved by a fall. GG

falling dune – An accumulation of sand that is formed as sand is blown off a mesa top or over a cliff face or steep slope, forming a solid wall, sloping at the angle of repose of dry sand, or a fan extending downward from a re-entrant in the mesa wall. Compare – climbing dune, sand ramp. GG

fall line - (not recommended; obsolete) An imaginary line or narrow zone connecting the water falls on several adjacent or near-parallel rivers, marking the points where these rivers make a sudden descent from an upland to a lowland, as at the edge of a plateau; specifically, the Fall Line marking the boundaries between the ancient, resistant crystalline rocks of the Piedmont Plateau and the younger, softer sediments of the Atlantic Coastal Plain of the Eastern United States. It also marks the limit of navigability of the rivers. Now considered an archaic term because Coastal Plain materials occur several miles west or inland of the Fall Line and current research is showing it to be a broad zone of high-angle reverse faults. GG

fan [geomorphology] - (a) A gently sloping, fan-shaped mass of detritus forming a section of a low-angle cone commonly at a place where there is a notable decrease in gradient; specifically an alluvial fan (not preferred – use alluvial fan). Compare – alluvial fan, alluvial cone. (b) A fan-shaped mass of congealed lava that formed on a steep slope by the continually changing direction of flow. GG

fan apron - A sheet-like mantle of relatively young alluvium and soils covering part of an older fan piedmont (and occasionally alluvial fan) surface, commonly thicker and further down slope (e.g., mid-fan or mid-fan piedmont) than a fan collar. It somewhere buries an older soil that can be traced to the edge of the fan apron where the older soil emerges as the land surface, or relict soil. No buried soils should occur within a fan-apron mantle itself. Compare – fan collar. FFP

fan collar – A landform comprised of a thin, short, relatively young mantle of alluvium along the very upper margin (near the proximal end or apex) of a major alluvial fan. The young mantle somewhere buries an older soil that can be traced to the edge of the collar where the older soil emerges at the land surface as a relict soil. Compare – fan apron. FFP

fanglomerate - A sedimentary rock consisting of waterworn, heterogeneous fragments of all sizes, deposited in an alluvial fan and later cemented into a firm rock. GG

fanhead trench - A linear depression formed by a drainageway that is incised considerably below the surface of an alluvial fan. GG

fan piedmont - The most extensive landform on piedmont slopes, formed by (a) the lateral, downslope, coalescence of mountain-front alluvial fans into one generally smooth slope with or without the transverse undulations of the semi-conical alluvial fans, and (b) accretions of fan aprons. FFP

fan remnant - A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected (erosional fan-remnants) or partially buried (nonburied fan-remnants). An erosional fan remnant must have a relatively flat summit that is a relict fan-surface. A nonburied fan-remnant is a relict surface in its entirety. Compare – eroded fan remnant, ballena. FFP.

fan remnant sideslope – (not preferred) refer to eroded fan-remnant sideslope.

fan skirt - The zone of smooth, laterally-coalescing, small alluvial fans that issue from gullies cut into the fan piedmont of a basin or that are coalescing extensions of the inset fans of the fan piedmont, and that merge with the basin floor at their toeslopes. These are generally younger fans which onlap older fan surfaces. FFP

fan terrace - (not preferred) refer to fan remnant

fault - A discrete surface (fracture) or zone of discrete surfaces separating two rock masses across which one mass has slid past the other. GG

fault block - A displaced crustal unit, formed during block faulting, that is bounded by faults, either completely or in part, and behaves as a coherent unit during tectonic activity. SW & GG

fault-block mountains - Mountains that formed primarily by block faulting, and commonly exhibit asymmetrical rotation and vertical displacement from a horizontal plane by large, coherent fault-block units hinged along fault lines; common in , but not limited to, the Basin and Range region of the US.. The term is not applied to mountains formed by thrust-faulting. SW & GG

fault line - The trace of a fault plane on the ground surface or on a reference plane. Compare - fault-line scarp. GG

fault-line scarp - (a) A steep slope or cliff formed by differential erosion along a fault line, as by the more rapid erosion of soft rock on the side of a fault as compared to that of more resistant rock on the other side; e.g. the east face of the Sierra Nevada in California. (b) (not recommended) A fault scarp that has been modified by erosion. This usage is not recommended because the scarp is usually not located on the fault line. GG

fault zone – A fault that is expressed as a zone of numerous small fractures or of breccia or fault gouge. A fault zone may be as wide as hundreds of meters. Compare – fault, fault-scarp. GG

felsenmeer - refer to block field. GG

felsic rock - A general term for igneous rock containing abundant, light-colored minerals (granite, etc); also applied to those minerals (quartz, feldspars, feldspathoids, muscovite) as a group. Compare - mafic rock. GG

fen - Waterlogged, spongy ground containing alkaline decaying vegetation, characterized by reeds, that develops into peat. It sometimes occurs in sinkholes of karst regions. Compare - bog, marsh, swamp. GG

fenster – see window.

fill [eng. geol] – (a) Human-constructed deposits of natural earth materials (e.g., soil, gravel, rock) and waste materials (e.g., tailings or spoil from dredging) used to fill a depression, to extend shore land into a body of water, or in building dams. (b) Soil or loose rock used to raise the surface level of low-lying land, such as an embankment to fill a hollow or ravine in roads construction. GG

filled marshland - A subaerial soil area composed of fill materials (construction debris, dredged or pumped sandy or shell-rich sediments, etc.) deposited and smoothed to provide building sites and associated uses (e.g. lawns, driveways, parking lots). These fill materials are typically 0.5 to 3 m thick and have been deposited unconformably over natural soils. Compare – dredge spoil bank. SW

finger ridge – One in a group of small, tertiary spur ridges that form crudely palmate extensions of erosional remnants along the flanks or nose of larger ridges. Compare – ballena, rib. SW

first bottom - (not recommended; colloquial: Midwest USA) refer to flood-plain step. An obsolete, informal term loosely applied to the lowest flood-plain steps that experience regular flooding. However, the frequency of flooding is inconsistently specified. SW

fissure vent – An opening in earth's surface of a volcanic conduit in the form of a crack or fissure rather than a localized crater; a roughly linear crack or area along which lava, generally mafic and of low viscosity, wells up to the surface, usually without any explosive activity. The results can be an extensive lava plateau (e.g. Columbia River Plateau). Compare – crater [volcanic]. SW & GG

fjord - A long, narrow, winding, glacially eroded, U-shaped and steep-walled, generally deep inlet or arm of the sea between high rocky cliffs of slopes along a mountainous coast. Typically it has a shallow sill or threshold of solid rock or earth material submerged near its mouth and becomes deeper far inland. A fjord usually represents the seaward end of a deep, glacially excavated valley that is partially submerged by drowning after melting of the ice. GG

flat -[geomorphology] - (a) (adjective) Said of an area characterized by a continuous surface or stretch of land that is smooth, even, or horizontal, or nearly so, and that lacks any significant curvature, slope, elevations, or depressions. (b) (noun) An informal, generic term for a level or nearly level surface or small area of land marked by little or no local relief. Compare - mud flat. (c) (not recommended) A nearly level region that visibly displays less relief than its surroundings. GG.

flat - [lake] (a) (not preferred) refer to lakebed. The low-lying, exposed, flat land of a lake delta or of a lake bottom. Compare - lake plain. (b) (not preferred) The flat bottom of a desiccated lake in the arid parts of western USA. Compare - playa, pluvial lake. GG

flatwoods – (colloquial – southeastern US) Broad, low gradient (generally < 1 % slope but up to 2% near drainageways), low relief interstream areas and characterized by non-hydric, poorly drained soils (seasonal saturation or water table) at depths of 15 -45 cm (6 – 18"), and naturally forested by pines that dominate the Lower Coastal Plain of the southeastern US. Regional differences occur in dominant vegetation and soil material (e.g. in south Florida, soils are dominantly sandy spodosols and the understory is dominantly saw palmetto). Hydropedologically and elevationally this landform occurs slightly above minor depressions (which have a seasonal water table at or above the surface), drainageways, and drainhead complexes, but lie below better drained and slightly higher small rises or knolls. Generally they are most extensive toward the interiors of low, broad interstream divides and away from drainageways. SW

flood plain - The nearly level plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the streams. HP

flood-plain landforms - A variety of constructional and erosional features produced by stream channel migration and flooding, e.g., backswamp, braided stream, flood-plain splay, meander, meander belt, meander scroll, oxbow lake, and natural levee. HP

flood-plain playa - A landform consisting of very low gradient, broad, barren, axial-stream channel segments in an intermontane basin. It floods broadly and shallowly and is veneered with barren fine-textured sediment that crusts. Commonly, a flood-plain playa is segmented by transverse, narrow bands of vegetation, and it may alternate with ordinary narrow or braided channel segments. FFP

flood-plain splay - A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (often coarse-grained) on the flood plain. Compare - crevasse. GG

flood-plain step - An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by flood water from the present stream (e.g., below the 100 year flood level); any approximately horizontal surface still actively modified by fluvial scour and/or deposition (i.e., cut and fill and/or scour and fill processes). May occur individually or as a series of steps. Compare – stream terrace. SW & RR

flood-tidal delta - A largely subaqueous (sometimes intertidal), crudely fan-shaped deposit of sand-sized sediment formed on the landward side of a tidal inlet (modified from Boothroyd et al., 1985; Davis, 1994; Ritter et al., 1995). Flood tides transport sediment through the tidal inlet and into the lagoon over a flood ramp where currents slow and dissipate (Davis, 1994). Generally, flood-tidal deltas along microtidal coasts are multi-lobate and unaffected by ebbing currents (modified from Davis, 1994). Compare – flood-tidal delta slope. SSS

flood-tidal delta flat - The relatively flat, dominant component of the flood-tidal delta. At extreme low tide this landform may be exposed for a relatively short period (modified from Boothroyd et al., 1985). SSS

flood-tidal delta slope - An extension of the flood-tidal delta that slopes toward deeper water in a lagoon or estuary, composed of flood channels, inactive lobes (areas of the flood-tidal delta that are not actively accumulating sand as a result of flood tides), and parts of the terminal lobe of the flood-tidal delta (modified from Boothroyd et al., 1985). SSS

floodwall - (not recommended) use levee.

floodway – a) A large-capacity channel constructed to divert floodwaters or excess streamflow from populous, flood-prone areas, such as a bypass route bounded by levees. b) The part of the flood plain kept clear of encumbrances and reserved for emergency diversion of floodwaters. GG

floor [geomorphology] - (a) A general term for the nearly level, lower part of a basin or valley; (not preferred) refer to basin floor, valley floor, (b) The bed of any body of water; e.g., the nearly level surface beneath the water of a stream, lake, or ocean. GG

flow [mass movement] - A category of mass movement processes, associated sediments (flow deposit) and landforms characterized by slow to very rapid downslope movement of unconsolidated material which, whether saturated or comparatively dry, behaves much as a viscous fluid as it moves. Types of flows can be specified based on the dominant particle size of sediments (i.e. debris flow (e.g., lahar), earth flow (creep, mudflow), rock fragment flow (e.g., rockfall avalanche), debris avalanche]. Compare - fall, topple, slide, lateral spread, complex landslide, landslide. SW & DV

flowtill - A till, commonly supraglacial, that is modified and transported by plastic mass flow; also spelled *flow till*. Compare - ablation till, basal till, lodgment till, mass-movement till, slump-till, supraglacial melt-out till. GG

flute [glacial] - A lineation or streamlined furrow or ridge parallel to the direction of ice movement, formed in newly deposited till or older drift. They range in height from a few centimeters to 25 m, and in length from a few meters to 20 km. Compare – glacial groove. GG

fluve - (refer to drainageway) A roughly linear or elongated depression (topographic low) of any size, along which water flows, at some time. Compare - interfluve. FFP & SW.

fluvial – (adjective) Of or pertaining to rivers or streams; produced by stream or river action. Compare – alluvial, colluvial. HP

fluviokarst – A karst landscape dominated by both 1) karst features (deranged and subsurface drainage, blind valleys, swallow holes, large springs, closed depressions, and caves), generally limited to low-lying interfluve areas, and 2) surface drainage by large rivers, with associated fluvial features (adjacent stream terraces) and sediments (alluvium), that commonly maintain their surface courses and are fed by underground tributaries; the dominant karst in the eastern USA. Compare – sinkhole karst, pavement karst, glaciokarst, karst. SW, WW, & GG

fluviomarine bottom - The nearly level or slightly undulating, relatively low-energy, depositional environment with relatively deep water (1.0 to >2.5 m) directly adjacent to an incoming stream and composed of interfingered and mixed fluvial and marine sediments (fluviomarine deposits). SSS

fluviomarine deposit – Stratified materials (clay, silt, sand, or gravel) formed by both marine and fluvial processes, resulting from non-tidal sea level fluctuations, subsidence and/or stream migration (i.e. materials originally deposited in a nearshore environment and subsequently reworked by fluvial processes as sea level fell). Compare – estuarine deposit, lacustrine deposit, lagoonal deposit, marine deposit, overbank deposit. SW

fluviomarine terrace – A constructional coastal strip, sloping gently seaward and/or down valley, veneered or completely composed of fluviomarine deposits (typically silt, sand, fine gravel). Compare – terrace, stream terrace, marine terrace. SW

fly ash – All particulate matter that is carried in a gas stream, especially in stack gases at a coal-fired plant for the generation of electric power; also name given to sediments from the same source, stock piled in settling ponds or spoil piles. SW & GG

fold [structural geology] - A curve or bend of a planar structure such as rock strata, bedding planes, foliation, or cleavage. GG

foothills - A steeply sloping upland composed of hills with relief of 30 up to 300 meters and fringes a mountain range or high-plateau escarpment. Compare - hill, mountain, plateau. SW & HP

footslope - The hillslope profile position that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope sites of deposition (toeslope). Compare - summit, shoulder, backslope, and toeslope. SW

foredune - A coastal dune or dune ridge oriented parallel to the shoreline, occurring at the landward margin of the beach, along the shoreward face of a beach ridge, or at the landward limit of the highest tide, and more or less stabilized by vegetation. GG

formation [stratigraphy] - The basic lithostratigraphic unit in the local classification of rocks. A body of rock (commonly a sedimentary stratum or strata, but also igneous and metamorphic rocks) generally characterized by some degree of internal lithologic homogeneity or distinctive lithologic features (such as chemical composition, structures, textures, or general kind of fossils), by a prevailing (but not necessarily tabular) shape, and is mappable at the earth's surface (at scales of the order of 1:25,000) or traceable in the subsurface. Formation may be combined into Groups or subdivided into members. Compare - bed. HP

fosse [glacial geology] - A long, narrow depression or trough-like hollow between the edge of a retreating glacier and the wall of its valley, or between the front of a moraine and its outwash plain. GG

free face - The part of a hillside or mountainside consisting of an outcrop of bare rock (scarp or cliff) that sheds colluvium to slopes below and commonly stands more steeply than the angle of repose of the colluvial slope (e.g. talus slope) immediately below. SW & GG

free face [geomorphology] – A geomorphic component of hills and mountains consisting of an outcrop of bare rock that sheds rock fragments and other sediments to, and commonly stands more steeply than the angle of repose of, the colluvial slope immediately below; most commonly found on shoulder and backslope positions, and can comprise part or all of a nose slope or side slope. Compare – interfluve, crest, nose slope, side slope, head slope, base slope. SW

freshwater marl – A soft, grayish to white, earthy or powdery, usually impure calcium carbonate precipitated on the bottoms of present-day freshwater lakes and ponds largely through the chemical action of algal mats and organic detritus, or forming deposits that underlie marshes, swamps, and bogs that occupy the sites of former (glacial) lakes. The calcium carbonate may range from 90% to less than 30%. Freshwater marl is usually gray; it has been used as a fertilizer for acid soils deficient in lime. Syn.: *bog lime*. Compare – marl, coastal marl. SW

fringe-tidal marsh - Narrow salt marsh adjacent to a relatively higher energy environment. SSS

frost boil - A small mound of fresh soil material formed by frost action. A type of nonsorted circle commonly found in fine-grained sediment underlain by permafrost, or formed in areas affected by seasonal frost. Compare - patterned ground. NRC

frost bursting - (not recommended) use frost shattering.

frost churning - (not recommended) use cryoturbation.

frost polygons - (not recommended) use (periglacial) patterned ground.

frost riving - (not recommended) use frost shattering.

frost shattering - The mechanical disintegration, splitting, or breakup of a rock or soil caused by the pressure exerted by freezing water in cracks or pores, or along bedding planes. Sometimes referred to as congelifraction. GG

frost splitting - (not recommended) use frost shattering.

frost stirring - (not recommended) use cryoturbation.

frost weathering - (not recommended) use frost shattering.

frost wedging - (not recommended) use frost shattering.

furrow – A linear or arcuate opening left in the soil after a plow or disk has opened a shallow channel at the soil surface. A shallow channel cut in the soil surface, usually between planted rows for controlling surface water and soil loss, or for conveying irrigation water. GSST

gap - A sharp break or opening in a mountain ridge, or a short pass through a mountain range; e.g., a wind gap. GG

gelifraction - (not recommended) use frost shattering.

gelivation - (not recommended) use frost shattering.

geomorphic component - A fundamental, three dimensional piece or area of a geomorphic setting (i.e., hills, mountains, terraces, flat plains) that has unique and prevailing kinetic energy dynamics and sediment transport conditions which result in their characteristic form, patterns of sedimentation and soil development. SW

geomorphic component - flat plains: - A group of fundamental, three dimensional pieces or areas of flat plains. In descending elevational order, the geomorphic components of a simple, flat plain (e.g. lake plain, low coastal plain, etc.) are the *rise* [a broad, slightly elevated area with comparatively greater gradients (e.g., 1-3% slopes], and the *talf* [a comparatively level (e.g., 0-1% slopes), laterally extensive, non-fluvial area], and *dip* [a slight depression that is not a permanent water body nor part of an integrated drainage network]. Compare - geomorphic component - terraces. SW

geomorphic component - hills: - A group of fundamental, three dimensional pieces or areas of hills. In descending elevational order, the geomorphic components of a simple hill are the *interfluve* (roughly analogous to the summit); *crest* (converged shoulders); 3 variations of the hillslope, each distinguished by the surface shape and the nature of overland flow: *head slope* (converging surface or overland flow, especially at the head of a drainageway), *side slope* (parallel surface flow), *nose slope* (diverging surface flow) *free face* (rock outcrop), and the *base slope* (colluvium / slope alluvium apron at the bottom of the hill). SW

geomorphic component - mountains: - A group of fundamental, three dimensional pieces or areas of mountains. In descending elevational order, the geomorphic components of a simple mountain are the *mountaintop* (roughly analogous to the crest or summit); *mountainflank* (the long slope along the sides of mountains which can be further subdivided into three portions based on the relative slope location: *upper third-*, *middle third-*, or *lower third mountainflank*); *free face* (rock outcrop); and the *mountainbase* (colluvium / slope alluvium apron at the bottom of the mountain). SW

geomorphic component – terraces, stepped landforms: - A group of fundamental, three dimensional pieces or areas of terraces, flood-plain steps, and other stepped landforms (e.g. stacked lava flow units). In descending elevational order, the geomorphic components are the *tread* (the level to gently sloping, laterally extensive top of a terrace, flood-plain step, or other stepped landform); and the *riser* (the comparatively short escarpment forming the more steeply sloping edge that descends to another level or a channel). SW

geomorphic surface - A mappable area of the earth's surface that has a common history; the area is of similar age and is formed by a set of processes during an episode of landscape evolution. A geomorphic surface can be erosional, constructional or both. The surface shape can be planar, concave, convex, or any combination of these. Compare constructional, erosional. RR

geomorphology - The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms. GG

geyser – A type of hot spring that intermittently erupts jets of hot water and steam, the result of ground water coming in contact with rock or steam hot enough to create steam under conditions preventing free circulation; a type of intermittent spring. Compare – mud pot, hot spring. GG

geyser basin – A valley that contains numerous springs, geysers, and steam fissures fed by the same ground-water flow. GG

geyser cone – A low hill or mound built up of siliceous sinter around the orifice of a geyser. GG

giant ripple - A ripple that is more than 30 m in length; e.g., the jokulhlaup derived giant ripples in Camas Prairie, MT.; it usually exhibits superimposed megaripples. Compare - ripple mark. GG

gilgai - A microfeature pattern of soils composed of a succession of microbasins and microknolls on level areas, or of microtroughs and microridges parallel to the slope on sloping areas, and produced by expansion / contraction and shear / thrust processes with changes in soil moisture. Found in soils containing large amounts of smectitic clay that swell and shrink considerably with wetting and drying. Various types of gilgai can be recognized based on the dominant shape of micro-highs and micro-lows: circular gilgai, elliptical gilgai, and linear gilgai. Also referred to, in part or in total, as crabhole, Bay of Biscay, or hushabye in older literature. SW & GSST

glacial - (adjective) (a) Of or relating to the presence and activities of ice and glaciers, as in glacial erosion. (b) Pertaining to distinctive features and materials produced by or derived from glaciers and ice sheets, as in glacial lakes. (c) Pertaining to an ice age or region of glaciation. GG

glacial drainage channel - A channel formed by an ice-marginal, englacial, or subglacial stream during glaciation. GG

glacial drift - (not recommended) use drift.

glacial groove – A deep, wide, usually straight furrow cut in bedrock by the abrasive action of a rock fragment embedded in the bottom of a moving glacier; it is larger and deeper than a glacial striation, ranging in size from a deep scratch to a small glacial valley. Compare – flute. GG

glacial lake - (a) A lake that derives much or all of its water from the melting of glacier ice, fed by meltwater, and lying outside the glacier margins (e.g. proglacial lake) or lying on a glacier (e.g. ice-walled lake, ice-floored lake) and due to differential melting. (b) A lake occupying a basin produced by glacial deposition, such as one held in by a morainal dam. (c) A lake occupying a basin produced in bedrock by glacial erosion (scouring, quarrying); e.g., cirque lake, fjord. (d) A lake occupying a basin produced by collapse of outwash material surrounding masses of stagnant ice. (e) [relict] An area formerly occupied by a glacial lake. GG

glacial-marine sedimentation - The accumulation of glacially eroded, terrestrially derived sediment in the marine environment. Sediment may be introduced by fluvial transport, by ice rafting, as an ice-contact deposit, or by eolian transport. Compare - glaciomarine deposits. GG

glacial outwash - (not recommended) use outwash.

glacial till - (not recommended; use till). Till should only be used for describing glacial sediments, therefore "glacial till" is redundant. GM

glacial-valley floor – The comparatively flat bottom of a mountain valley predominantly mantled by till but which can grade from glacial scour (scoured rock-outcrop) near it's head to a thick mantle of till, and ultimately merging with alluvium or colluvium further down valley. Some glacial-valley floors descend downstream in a series of scour-derived steps which may contain sequential tarn lakes (*pater noster lakes*); (not preferred: colloquial – western USA) sometimes called a trough bottom. SW

glacial-valley wall – The comparatively steep, glacially scoured, concave sides of a u-shaped, mountain valley mantled by colluvium with little or no till; (not preferred: colloquial – western USA) sometimes called a trough wall. SW

glaciation - The formation, movement and recession of glaciers or ice sheets. A collective term for the geologic processes of glacial activity, including erosion and deposition, and the resulting effects of such action on the earth's surface. GG

glacier - a) A large mass of ice formed, at least in part, on land by the compaction and recrystallization of snow, moving slowly by creep downslope or outward in all directions due to the stress of its own weight, and surviving from year to year. Included are small mountain glaciers as well as ice sheets continental in size, and ice shelves which float on the ocean but are fed in part by ice formed on land. b) A stream-like landform having the appearance of, or moving like a glacier; e.g. a rock glacier. Compare – snowfield, rock glacier. GG

glacier outburst flood – A sudden, often annual, release of meltwater from a glacier or glacier-damned lake sometimes resulting in a catastrophic flood, formed by melting of a drainage channel or buoyant lifting of ice by water or by subglacial volcanic activity; also called jokuhlaup. Compare – scabland, giant ripple. GG

glaciofluvial deposit - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces. Compare - drift and outwash. HP

glaciokarst – Karst in glaciated terrain developed on bedrock susceptible to dissolution (e.g. limestone), thinly mantled (e.g. < 5 - 30 m) with glacial drift and characterized by surficial, closed depressions formed by post-glacial, subsurface karstic collapse (e.g. sinkholes) rather than by glacial processes (e.g. ice-block melt-out); common in IN, MI. Compare – karst. SW & GG

glaciolacustrine deposit - Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are bedded or laminated with varves or rhythmites. HP

glaciomarine deposit - Glacially eroded, terrestrially derived sediments (clay, silt, sand, and gravel) that accumulated on the ocean floor. Sediments may be accumulated as an ice-contact deposit, by fluvial transport, ice-rafting, or eolian transport. GG & GM

glade – (colloquial – Ozark uplands, USA) (a) A largely treeless, open, grassy area (e.g., oak savanna) on high, broad interfluves and hillsides, commonly with shallow soils. Compare – park. SW (b) (not preferred) refer to park: An ecological term for a grassy, open depression or small valley as in a high meadow; sometimes marshy and forming the headwaters of a stream, or a low, grassy marsh that is periodically inundated. GG & SW

glauconite pellets – Silt to sand-sized, nodular aggregates with a characteristic greenish color, dominantly composed of the clay mineral glauconite; formed in near-shore marine sediments and subsequently exposed by a drop in sea level or rise of a land mass, as on a coastal plain. Glauconite pellets have a high potassium content and higher CEC and moisture retention compared to other mineral sands. Compare – greensands. SW

gorge - (a) A narrow, deep valley with nearly vertical, rocky walls, smaller than a canyon, and more steep-sided than a ravine; especially a restricted, steep-walled part of a canyon. (b) A narrow defile or passage between hills or mountains. GG

graben - An elongate trough or basin bounded on both sides by high-angle, normal faults that dip towards the interior of the trough. It is a structural form that may or may not be geomorphically expressed as a rift valley. Compare – horst, half graben. GG

granitoid – a) In the IUGS classification, a preliminary term for (for field use) for a plutonic rock with Q (quartz) between 20 and 40 (%). b) A general term for all phaneritic igneous rocks (*mineral crystals visible unaided and all about the same size)* dominated by quartz and feldspars. SW & GG

Grady pond – see Carolina Bay

grassy organic materials - see organic materials

gravel pit – A depression, ditch or pit excavated to furnish gravel for roads or other construction purposes; a type of borrow pit. SW

greensands – a) An unconsolidated, near-shore marine sediment containing substantial amounts of dark greenish glauconite pellets, often mingled with clay or sand (quartz may form the dominant constituent); prominent in Cretaceous and Tertiary coastal plain strata of New Jersey, Delaware and Maryland; has been commercially mined for potassium fertilizer. The term is loosely applied to any glauconitic sediment. b) (Not Preferred – use glauconitic sandstone) A sandstone consisting of greensand that is commonly poorly cemented, and has a greenish color when unweathered but an orange or yellow color when weathered. Compare – glauconite pellets. SW

grike – (not preferred) refer to cutter.

groove – A small, natural, narrow drainageway on high angle slopes which separate tertiary spur ridges or mini-interfluves and is a constituent part of *rib and groove topography*; common in well dissected uplands. Compare – rib. SW

ground moraine - (a) Commonly an extensive, low relief area of till, having an uneven or undulating surface, and commonly bounded on the distal end by a recessional or end moraine; (b) A layer of poorly sorted rock and mineral debris (till) dragged along, in, on, or beneath a glacier and deposited by processes including basal lodgment and release from downwasting stagnant ice by ablation. Compare - end moraine, recessional, moraine, terminal moraine. SW

ground soil – Any soil at the present-day land surface and actively undergoing pedogenesis, regardless of its history (i.e., relict, exhumed). Compare – buried soil. SW & RR

grus - The fragmental products of in situ granular disintegration of granite and granitic rocks, dominated by inter-crystal disintegration. Compare - saprolite. SW & GG

gulch - (colloquial: western U.S.A.; not preferred – refer to ravine) A small stream channel, narrow and steep-sided in cross section, and larger than a gully, cut in unconsolidated materials. General synonym - ravine. Compare - arroyo, draw, gully, wash. HP

gulf [coast] – A relatively large part of an ocean or sea extending far into the land, partly enclosed by an extensive sweep of the coast, and opened to the sea through a strait (e.g. Gulf of Mexico); the largest of various forms of inlets of the sea. It is usually larger, more enclosed, and more deeply indented than a bay. Compare – bay. GG

gully - A small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water usually during and immediately following heavy rains or ice / snow melt. A gully generally is an obstacle to wheeled vehicles and too deep (e.g., > 0.5 m) to be obliterated by ordinary tillage; (a rill is of lesser depth and can be smoothed over by ordinary tillage). Compare - rill, ravine, arroyo, swale, draw. HP & GSST

gut - (a) (colloquial: U.S. Virgin Islands, Caribbean Basin) A gully, ravine, small valley, or narrow passage on land. (b) [stream] (not preferred – use tidal channel) A tidal stream connecting two larger waterways within a lagoon, estuary or bay. SW & GG

half graben – An elongate, structural trough or basin bounded on one side by a normal fault. It may or may not produce a topographic basin. Compare – graben. GG

hanging valley - A tributary valley whose floor at the lower end is notably higher than the floor of the main valley in the area of junction. GG

head [geomorphology] - (a) The source, beginning, or upper part of a stream. (b) The upper part or end of a slope or valley. GG

headland [coast] - (a) An irregularity of land, especially of considerable height with a steep cliff face, jutting out from the coast into a large body of water (usually the sea or a lake); a bold promontory or a high cape. (b) The high ground flanking a body of water, such as a cove. (c) The steep crag or cliff face of a promontory. GG

head-of-outwash – A sloping and sometimes high relief landform composed predominantly of glaciofluvial sediment that delimits a former ice-margin of a relatively static, rapidly wasting glacier. A steep *ice-contact slope* forms the ice-proximal face of the landform; a more gently sloping surface dips away on the distal slope, if not slumped. Compare – ice-margin complex. SW

head slope [geomorphology] - A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway, resulting in converging overland water flow (e.g. sheet wash); head slopes are dominated by colluvium and slope wash sediments (e.g., slope alluvium); contour lines form concave curves. Slope complexity (downslope shape) can range from simple to complex. Headslopes are comparatively moister portions of hillslopes and tend to accumulate sediments (e.g., cummulic profiles) where they are not directly contributing materials to channel flow. Compare - side slope, nose slope, free face, interfluve, crest, base slope. SW.

headwall - A steep slope at the head of a valley; e.g. the rock cliff at the back of a cirque. Compare – cirque headwall. GG

herbaceous organic materials - see organic materials.

herbaceous peat [Soil Taxonomy] - An accumulation of organic material, decomposed to some degree, that is predominantly the remains of sedges, reeds, cattails and other herbaceous plants. Compare - moss peat, sedimentary peat, woody peat, peat, muck, and mucky peat. SSM

high-center polygon - A polygon whose center is raised relative to its boundary. Compare - low center polygon. NRC

high hill – A generic name for an elevated, generally rounded land surface with high local relief, rising between 90 meters (approx. 300 ft.) to as much as 300 m (approx. 1000 ft.) above surrounding lowlands. Compare – low hill, hill, hillock. SW

highmoor bog - A bog, often on the uplands, whose surface is covered by sphagnum mosses which, because of their high degree of water retention, make the bog more dependent upon precipitation than on the water table. The bog often occurs as a raised peat bog or blanket bog. Compare - lowmoor bog, raised bog. GG

hill - A generic term for an elevated area of the land surface, rising at least 30 m (100 ft.) to as much as 300 meters (approx. 1000 ft.) above surrounding lowlands, usually with a nominal summit area relative to bounding slopes, a well-defined, rounded outline and slopes that generally exceed 15 percent. A hill can occur as a single, isolated mass or in a group. A hill can be further specified based on the magnitude of local relief: *low hill* (30 – 90 m) or *high hill* (90 - 300 m). Informal distinctions between a hill and a mountain are often arbitrary and dependent on local convention. Compare - hillock, plateau, mountain, foothills, hills. SW & HP

hillock – A generic name for a small, low hill, generally between 3 – 30 m in height and slopes between 5 and 50% (e.g., bigger than a mound but smaller than a hill); commonly considered a microfeature. Compare – mound, hill. SW

hills – A landscape dominated by hills and associated valleys. SW

hillside - (not recommended) use hillslope.

hillslope - A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill. Compare – mountain slope. HP

hillslope-profile position - Discrete slope segments found along a transect line that runs perpendicular to the contour, beginning at a divide and descending to a lower, bounding stream channel or valley floor; a discrete piece of a two-dimensional cross profile of a hill. Positions are commonly separated from one another by inflection points along the line. In descending elevational order, the hillslope-profile positions of a simple hillslope include summit, shoulder, backslope, footslope, and toeslope. Not all of these segments (positions) are necessarily present along a particular hillslope. Complex hillslopes include multiple sequences or partial sequences, or partial sequences. Compare - geomorphic components - hills. SW, HP, & RR

hillslope terrace – A raised, generally horizontal strip of earth and/or rock bounded by a down-slope berm or retaining wall, constructed along a contour on a hillslope to make land suitable for tillage and to prevent accelerated erosion; common in steep terrain, both archaic (e.g. Peru) and modern (e.g. Nepal). Compare – conservation terrace. SW & GSST

hill top (not recommended) use summit.

hogback - A sharp-crested, symmetric ridge formed by highly tilted resistant rock layers; a type of homocline produced by differential erosion of interlayered resistant and weak rocks with dips greater than about 25 $^{\circ}$ (or approximately > 45 % slopes). Compare – homoclinal ridge, cuesta. SW & HP

Holocene - The epoch of the Quaternary Period of geologic time following the Pleistocene Epoch (from the present to about 10 to 12 thousand years ago); also corresponding (time-stratigraphic) "series" of earth materials. SW

homoclinal [structural geomorphology] - (adjective) Pertaining to strata that dip in one direction with a uniform angle. Compare - cuesta, hogback, homoclinal ridge. HP

homoclinal ridge – An intermediate form of homocline that forms an asymmetric ridge with a dip slope commonly between 10 – 25 $^{\circ}$ (or approximately 15 – 45 % slopes); greater dip than a cuesta and lower dip than a hogback. Compare - cuesta, hogback. SW & RF

homocline - A general term for a series of rock strata that dip in one direction with a uniform angle; e.g. one limb of a fold, a tilted fault block, or an isocline. Compare - cuesta, homoclinal ridge, hogback. GG

hoodoo - A bizarrely shaped column, pinnacle, or pillar of rock produced by differential weathering or erosion in a region of sporadically heavy rainfall. Formation is facilitated by joints and layers of varying hardness. Compare - earth pillar. GG

horn [glacial geology] - A high, rocky, sharp pointed, steep-sided, mountain peak with prominent faces and ridges, bounded by the intersecting walls of three or more cirques that have been cut back into the mountain by headward erosion of glaciers. GG

horst - An elongate block that is bounded on both sides by normal faults that dip away from the interior of the horst. It is a structural form and may or may not be expressed geomorphically. GG

hot spring – A natural, geothermally heated spring whose temperature is above that of the human body. Compare – geyser, mud pot. GG

hummock - [geomorphology] (a) (not preferred – see hillock). An imprecise, general term for a rounded or conical mound or other small elevation. (b) (not preferred) A slight rise of ground above a level surface. GG.

hummock -[patterned ground] A small, irregular knob of earth (earth hummock) or turf (turf hummock). Neither type of hummock is diagnostic of permafrost, but both are most common in subpolar or alpine regions. Both require vegetative cover. GG

ice age - (not recommended) use Pleistocene.

ice-contact slope – A steep escarpment of predominantly glaciofluvial sediment that was deposited against a wall of glacier ice, marking the position of a relatively static ice-margin; an irregular scarp against which glacier ice once rested. Compare – head-of-outwash. SW & GG

ice-marginal stream – A stream drainage along the side or front of a glacier. Relict ice-marginal streams are used to trace the former position of a glacier; also called ice-marginal drainage. SW & GG

ice-margin complex – An assemblage of landforms constructed proximal to a relatively static, rapidly wasting continental glacial margin. Constituent landforms can include fosse, head-of-outwash, ice-contact slope, ice-contact delta, kame, kame moraine, kettle, outwash fan, small outwash plain, glacial sluiceway, and small proglacial lake. Moraines, if present, are of limited occurrence (except kame moraines which can be extensive). Glaciofluvial sediments dominate but glaciolacustrine sediments, till, and diamictons can be present in minor amounts. SW

ice-pushed ridge - An asymmetrical ridge of local, essentially non-glacial material (such as deformed bedrock, with some drift incorporated in it) that has been pressed up by the shearing action of an advancing glacier. It is typically 10 - 60 m high, about 150 - 300 m wide, and as much as 5 km long. Examples are common on the Great Plains where such ridges occur on the sides of escarpments formed of relatively incompetent rocks that face the direction from which the ice moved. GG

ice-rafting - The transportation of rock fragments of all sizes on or within icebergs, ice floes, or other forms of floating ice. Compare - dropstone, erratic. GG

ice segregation - The formation of ice by the migration of pore water to the frozen fringe where it forms into discrete layers or lenses. It commonly ranges in thickness from hairline to more than 10 m and often occurs in alternating layers of ice and soil. NRC

ice wedge - A massive, generally wedge-shaped body with its apex pointing downward, composed of foliated or vertically banded, commonly white, ice. NRC

ice wedge cast - A filling of sediment in the space formerly occupied by an ice wedge. NRC

ice wedge polygon - Patterned ground in areas of ice wedges. These polygons are commonly in poorly-drained areas and may be high-centered or low-centered. NRC

igneous rock - Rock formed by cooling and solidification from magma, and that has not been changed appreciably by weathering since its formation; major varieties include plutonic and volcanic rocks. Examples: andesite, basalt, granite. Compare - intrusive, extrusive, metamorphic rock. GSST & HP

inlet - A short, narrow waterway connecting a bay, lagoon, or similar body of water. Compare – tidal inlet. GG

impact crater – a) [anthropogenic] A generally circular or elliptical depression formed by hypervelocity impact of an experimental projectile or ordinance into earthy or rock material. Compare – caldera, crater, meteorite crater. SW; b) (not recommended – use meteorite crater) A generally circular crater formed by the impact of an interplanetary body (projectile) on a planetary surface. GG

inselberg - A prominent, isolated, residual knob, hill, or small mountain, usually smoothed and rounded, rising abruptly from an extensive lowland erosion surface in a hot dry region; generally bare and rocky although the lower slopes are commonly buried by colluvium. Compare - monadnock, nunatak. GG

inset fan - (colloquial; southwestern USA) The flood plain of an ephemeral stream that is confined between the fan remnants, ballenas, basin-floor remnants, or closely-opposed fan toeslopes of a basin. FF & SW.

integrated drainage - A general term for a drainage pattern in which stream systems have developed to the point where all parts of the landscape drain into some part of a stream system, the initial or original surfaces have essentially disappeared and the region drains to a common base level. Few or no closed drainage systems are present. SW

interbedded - Said of beds lying between or alternating with others of different character; especially said of rock material or sediments laid down in sequence between other beds, such as "interbedded" sands and gravels. GG

interdrumlin – The concave to relatively flat bottomed, roughly linear depressions ranging from small saddles or swales to small valleys that separate drumlins or drumlinoid ridges in drumlin fields. Streams, if present, have not had a dominant impact on the formation of the depression. Compare – drumlin, drumlinoid ridge. SW

interdrumlin swale – see interdrumlin

interdune - The relatively flat surface, whether sand-free or sand-covered, between dunes. GG

interdune valley - A broad interdune area consisting of a low-lying, relatively flat surface commonly found between very large dunes, and which lies in close proximity the local groundwater table (if present). SW

interfluve - A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways. Compare - divide. GG & FFP

interfluve [geomorphology] - A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloped area of a hill; shoulders of backwearing hillslopes can narrow the upland (e.g., ridge) or merge (e.g., crest, saddle) resulting in a strongly convex shape. Compare – crest, side slope, head slope, nose slope, free face, base slope. SW

interior valley – A large, flat-floored closed depression in a karst area whose drainage is ultimately subsurface and its floor is commonly covered by alluvium. Some interior valleys may become ephemeral lakes during periods of heavy rainfall, when sinking streams that drain them cannot manage the runoff; also called polje (not preferred). Compare – karst valley, sinkhole. GG

intermediate position [gilgai] – A nearly level area, including the lower part (footslope) of a micro-high, that is a transition zone between the slightly elevated micro-high (i.e. microknoll; *mound* in Russia) and the outer edge of an adjacent micro-low (i.e. microbasin, microtrough; *depression* in Russia) in gilgai or other patterned ground. Where present, it can make up a majority of the ground surface area in gilgai; called *slope* in Russia. Compare – gilgai. SW

intermittent stream - A stream, or reach of a stream, that does not flow year-round (commonly dry for 3 or more months out of 12) and whose channel is generally below the local water table; it flows only when it receives a) base flow (i.e. solely during wet periods), or b) ground-water discharge or protracted contributions from melting snow or other erratic surface and shallow subsurface sources. Compare - ephemeral stream. HP

intermontane basin - A generic term for wide structural depressions between mountain ranges that are partly filled with alluvium and called "valleys" in the vernacular. Intermontane basins may be drained internally (bolsons) or externally (semi-bolson). FFP

interstream divide - (a) (not preferred) A synonym for divide. (b) (colloquial - esp. southeastern USA). *Broad* interstream divide - A wide, relatively level area between incised drainageways; a broad, nearly level "summit" or interfluve. Compare - broad interstream divide, interfluve. SW

intertidal - (adjective) The coastal environment between mean low tide and mean high tide that alternates between subaerial and subaqueous depending on the tidal cycle. Compare – subtidal. SSS

intramorainal - said of deposits and phenomena occurring within a lobate curve of a moraine (e.g. within the area occupied by a glacier). Compare - extramorainal. GG

intrusive - Denoting igneous rocks derived from molten matter (magmas) that invaded pre-existing rocks and cooled below the surface of the earth. Compare - extrusive. HP

island - (a) An area of land completely surrounded by water. Compare – barrier island, coral island. (b) An elevated area of land surrounded by swamp, or marsh, or isolated at high water or during floods. Compare - barrier island. GG

joint [geology] - A surface of actual or potential fracture or parting in a rock, without displacement; the surface is usually planar and often occurs with parallel joints to form part of a joint set. HP

jokulhlaup - An Icelandic term for a glacial outburst flood, especially when an ice dam impounding a glacial lake breaks. Such breaks drained glacial Lake Missoula and created the Channeled Scablands in the Pacific Northwest. (Pronounced: yo-kool-loup, the last syllable as in "out".) Compare – glacier outburst flood, scabland, giant ripple. SW & GG

kame - A low mound, knob, hummock, or short irregular ridge, composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice. Compare - crevasse filling, kame moraine, kame terrace, esker, outwash. GG

kame moraine - (a) An end moraine that contains numerous kames. (b) A group of kames along the front of a stagnant glacier, commonly comprising the slumped or erosional remnants of a formerly continuous outwash plain built up over the foot of rapidly wasting or stagnant ice. GG

kame terrace - A terrace-like ridge consisting of stratified sand and gravel (a) deposited by a meltwater stream flowing between a melting glacier and a higher valley wall or lateral moraine, and (b) left standing after the disappearance of the ice. It is commonly pitted with "kettles" and has an irregular ice-contact slope. HP

karren – Repeating, surficial solution channels, grooves or other forms etched onto massive, bare limestone surfaces; types range in depth from a few millimeters to > 1 m and separated by ridges; the total complex (all varieties) of surficial solution forms found on compact, pure limestone. Many types can be specified. Compare – solution fissure. SW & GG

karst - A kind of topography formed in limestone, gypsum, or other soluble rocks by dissolution, and that is characterized by closed depressions, sinkholes, caves, and underground drainage. Various types of karst can be recognized depending upon the dominant surface features: karst dominated by closed depressions (*sinkhole karst* – temperate climates; *cockpit karst* – humid tropical climates), closed depressions and large rivers (*fluviokarst*), bare rock dominated by dissolution joints (*pavement karst*), tropical cone-, tower- or domed-hills (*kegel karst*), or karst thinly mantled with glacial drift (*glaciokarst*), etc. SW & WW

karst cone – A conically-shaped residual hill in karst with a rounded top and relatively steep, convex (e.g. parabolic) side slopes, commonly in tropical climates. Compare – karst tower, mogote. SW & WW

karst drainage pattern – A drainage pattern that lacks an integrated drainage system associated with soluble rocks with little or no surface drainage but a considerable underground, internal drainage system; characteristic of karst landscapes underlain by limestone, gypsum, or salt. SW

karstic – (adjective) Having the attributes of karst. SW & GG

karstic marine terrace – A relict, wave-cut terrace or solution platform formed across soluble bedrock (e.g. limestone), and subsequently subaerially weathered by solution resulting in prominent karst features (e.g. sinkholes, karst valleys, solution pipes, etc.); a type of marine terrace, extensive across the Florida peninsula. Dunefields and sand sheets of reworked coastal / fluviomarine sands are common capping materials. SW

karst lake – A large area of standing water in an extensive closed depression in soluble bedrock (e.g. limestone) and commonly is directly connected to and controlled by the subsurface karst drainage network. SW & GG

karstland – (not preferred) use karst. A landscape dominated by dissolution features (e.g., sinkhole, blind valley, closed depressions, underground drainage) formed in soluble rocks. SW & GG

karst tower – An isolated, separate hill or ridge in a karst region consisting of an erosional remnant of limestone or other sedimentary rocks with vertical or near-vertical, convex side slopes and commonly surrounded by an alluvial plain, lagoon, or deep rugged ravines. Compare – mogote, karst cone. SW

karst valley – A closed depression formed by the coalescence of multiple sinkholes; an elongate, solutional valley. Its drainage is subsurface, diameters range from several hundred meters to a few kilometers, and it usually has a scalloped margin inherited from the sinkholes. It may have nominal, local channel flow (small streams), sequential sinkhole inlets (springs) and outlets (swallow hole, etc.); also called compound sinkhole (not preferred), uvala (not preferred). Compare – sinkhole, interior valley. SW & GG

kegel karst – A general name used to describe several types of humid tropical karst landscapes characterized by numerous, closely spaced cone- (cone karst), hemispherical- (halbkugelkarst), or tower-shaped (tower karst) hills with vertical or near-vertical walls and having intervening closed depressions and narrow steep-walled karst valleys or passageways. Compare – cockpit karst. GG & SW

kettle - A steep-sided, bowl-shaped depression commonly without surface drainage (closed depression) in drift deposits, often containing a lake or swamp, and formed by the melting of a large, detached block of stagnant ice that had been wholly or partly buried in the drift. Kettles range in depth from 1 to tens of meters, and with diameters up to 13 km. Compare - pothole. GG

kipuka - A low "island" of land surrounded by a younger (more recent) lava flow. Compare - steptoe. MA

kluftkarren – (not preferred) refer to solution fissure.

knickpoint - (a) A point of abrupt inflection in the longitudinal profile of a stream or of its valley (e.g. a waterfall); it marks the maximum headward erosion of a new erosion cycle that grades to a new, lower base level; (b) Any interruption or break in slope. SW

knob - (a) A rounded eminence, a small hill or mountain; especially a prominent or isolated hill with steep sides, commonly found in the Southern United States. (b) A peak or other projection from the top of a hill or mountain. Also, a boulder or group of boulders or an area of resistant rocks protruding from the side of a hill or mountain. Compare – stack [geom]. GG

knoll - A small, low, rounded hill rising above adjacent landforms. HP

lacustrine deposit - Clastic sediments and chemical precipitates deposited in lakes. HP

lagoon - [coast] A shallow stretch of salt or brackish water, partly or completely separated from a sea or lake by an offshore reef, barrier island, sandbank or spit. GG'87. [relict landform] A nearly level, filled trough or depression behind the longshore bar on a barrier beach and built by a receding pluvial or glacial lake. Compare - sewage lagoon. FFP

lagoonal deposit – Sand, silt or clay-sized sediments transported and deposited by wind, currents, and storm washover in the relatively low-energy, brackish to saline, shallow waters of a lagoon. Compare – estuarine deposit, fluviomarine deposit, marine deposit. SSS

lagoon bottom - The nearly level or slightly undulating central portion of a submerged, low-energy, depositional estuarine basin (McGinn, 1982) characterized by relatively deep water (1.0 to >2.5 m). Compare – bay bottom. SSS

lagoon channel - A subaqueous, sinuous area within a lagoon that likely represents a relict channel (paleochannel, Wells et al., 1994) that is maintained by strong currents during tidal cycles (Short, 1975). SSS

lahar - The process, associated sediments or resultant landform characterized by a mudflow composed chiefly of volcaniclastic materials on or near the flank of a volcano. The debris carried in the flow includes pyroclastic material, blocks from primary lava flows, and epiclastic material. Thick flows can exhibit a crude (poorly sorted) upward-fining sediment sequence. Compare - mudflow. SW & GG

lake [water] - An inland body of permanently standing water fresh or saline, occupying a depression on the Earth's surface, generally of appreciable size (larger than a pond) and too deep to permit vegetation (excluding subaqueous vegetation) to take root completely across the expanse of water. GG

lakebed - (a) [relict] The flat to gently undulating ground underlain or composed of fine-grained sediments deposited in a former lake. (b) The bottom of a lake; a lake basin. GG

lake plain - A nearly level surface marking the floor of an extinct lake filled by well-sorted, generally fine-textured, stratified deposits, commonly containing varves. GG

lakeshore - The narrow strip of land in contact with or bordering a lake; especially the beach of a lake. GG

lake terrace - A narrow shelf, partly cut and partly built, produced along a lake shore in front of a scarp line of low cliffs and later exposed when the water level falls. GG

lamella - (a) [soil] A thin (< 7.5 cm thick), discontinuous or continuous, generally horizontal layer of fine material (especially clay and iron oxides) that has been pedogenically concentrated (illuviated) within a coarser (e.g. sandy), eluviated layer (several centimeters to several decimeters thick). Compare - lamina.

SW & ST (b) [mineralogy] A thin scale, leaf, lamina, or layer, e.g. one of the units of a polysynthetically twinned mineral, such as plagioclase. GG

lamina - (noun) The thinnest recognizable layer (commonly < 1 cm thick) of original deposition in a sediment or sedimentary rock, differing from other layers in color, composition, or particle size. Several laminae constitute a bed. Compare - lamella. GG

lamination - (not recommended) see lamina.

landfill - (see sanitary landfill). Compare - dump.

landform - Any physical, recognizable form or feature on the earth's surface, having a characteristic shape and range in composition, and produced by natural causes; a distinct individual. It can span a wide range in size (e.g., *dune* encompasses both *parabolic dune*, which can be several tens-of-meters across, as well as *seif dune* which can be up to 100 kilometers long. Landforms provide an empirical description of similar portions of the earth's surface. SW & GG

landscape [soils] An assemblage, group, or family of spatially related, natural landforms over a relatively large area; the land surface which the eye can comprehend in a single view. SW & GSST

landslide [mass movement] – A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials, caused by gravitational forces and which may or may not involve saturated materials. Names of landslide types generally reflect the dominant process and/or the resultant landform. The main operational categories of mass movement are *fall* (rockfall, debris fall, soil fall), *topple* (rock topple, debris topple, soil topple), *slide* (rotational landslide, block glide, debris slide, lateral spread), *flow* [rock fragment flow (especially rockfall avalanche), debris avalanche, debris flow (e.g., lahar), earthflow, (creep, mudflow)], and *complex landslides*. Compare – solifluction. SW & DV

land-surface form - The description of a given terrain unit based on empirical analysis of the land surface rather than interpretation of genetic factors. Surface form may be expressed quantitatively in terms of vertical and planimetric slope-class distribution, local and absolute relief, and patterns of terrain features such as interfluve crests, drainage lines, or escarpments. HP

lapilli - Non or slightly vesicular pyroclastics, 2.0 to 76 mm in at least one dimension, with an apparent specific gravity of 2.0 or more. Compare - ash [volcanic], block [volcanic], cinders, tephra. KST

lateral moraine - A ridge-like moraine carried on and deposited at the side margin of a valley glacier. It is composed chiefly of rock fragments derived from valley walls by glacial abrasion and plucking, or colluvial accumulation from adjacent slopes. GG

lateral spread [mass movement] –A category of mass movement processes, associated sediments (lateral spread deposit) or resultant landforms characterized by a very rapid *spread* dominated by lateral movement in a soil or fractured rock mass resulting from liquefaction or plastic flow of underlying materials; also called spread. Types of lateral spreads can be specified based on the dominant particle size of sediments (i.e. debris spread, earth spread, rock spread. Compare – fall, topple, slide, flow, complex landslide, landslide. SW, DV & GG

lava – A general term for a molten extrusive, also the rock solidified from it. GG

lava channel – see lava trench.

lava field – An area covered primarily by lava flows whose terrain can be rough and broken or relatively smooth; it can include vent structures (e.g., small cinder cones, spatter cones, etc.), surface flow structures (e.g., pressure ridges, tumuli, etc.) and small, intermittent areas covered with pyroclastics. Compare – lava plain, volcanic field. SW

lava flow - A solidified body of rock formed from the lateral, surficial outpouring of molten lava from a vent or fissure, often lobate in form. Compare - **`a`a** lava flow, lava flow unit, pahoehoe lava flow. GG

lava flow unit – A separate, distinct lobe of lava that issues from the main body of a lava flow; a specific outpouring of lava, a few centimeters to several meters thick and of variable lateral extent, that forms a subdivision within a single flow. A series of overlapping lava flow-units together comprise a single lava flow. Also called flow unit. Compare – lava flow. GS & GG

lava plain - A broad area of nearly level land, that can be localized but is commonly hundreds of square kilometers in extent, covered by a relatively thin succession of primarily basaltic lava flows resulting from fissure eruptions. Compare – lava plateau, lava field, volcanic field. SW & GG

lava plateau - A broad elevated tableland or flat-topped highland, that may be localized but commonly is many hundreds or thousands of square kilometers in extent, underlain by a thick succession of basaltic lava flows resulting from fissure eruptions (e.g. Columbia River Plateau). Compare – lava plain, lava field. GG

lava trench – A natural surface channel in a lava flow that never had a roof, formed by the surficial draining of molten lava rather than by erosion from running water; also called lava channel. Compare – mawae, lava tube. SW

lava tube - A natural, hollow tunnel beneath the surface of a solidified lava flow through which the lava flow was fed; the tunnel was left empty when the molten lava drained out. MA & GG

ledge - (a) A narrow shelf or projection of rock, much longer than wide, formed on a rock wall or cliff face, as along a coast by differential wave action on softer rocks; erosion is by combined biological and chemical weathering. (b) A rocky outcrop; solid rock. (c) A shelf-like quarry exposure or natural rock outcrop. Compare - structural bench. GG

lee – (adj.) Said of a side or slope that faces away from an advancing glacier or ice sheet, and facing the downstream ("down-ice") side of a glacier and relatively protected from its abrasive action. Compare – stoss, stoss and lee, crag and tail. GG

levee [streams] - An artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel. Compare artificial levee, natural levee. GG

leveled land – A land area, usually a field, that has been mechanically flattened or smoothed to facilitate management practices such as flood irrigation; as a result the natural soil has been partially or completely modified (e.g., truncated or buried). SW

limestone - A sedimentary rock consisting chiefly (more than 50 percent) of calcium carbonate, primarily in the form of calcite. Limestones are usually formed by a combination of organic and inorganic processes and include chemical and clastic (soluble and insoluble) constituents; many contain fossils. HP

limestone pavement – (not preferred) refer to pavement karst.

linear gilgai – A type of gilgai dominated by parallel micro-low troughs separated by low ridges (micro-highs) and oriented perpendicular to the topographic contour (i.e., up and down slopes); the prevailing type of gilgai on sloping terrain (slopes > 8 %). Compare – circular gilgai, elliptical gilgai, gilgai. SW

lithification - The conversion of unconsolidated sediment into a coherent and solid rock, involving processes such as cementation, compaction, desiccation, crystallization, recrystallization, and compression. It may occur concurrently with, shortly after, or long after deposition. HP

lithologic - (adjective) Pertaining to the physical character of a rock. HP

local relief - A general term referring to the prevailing difference in elevation between the lowest and highest parts of the landscape at a given locale (e.g. the average difference in elevation between a representative portion of a valley floor and the tops of the bounding valley walls). SW

lodgment till - A basal till commonly characterized by compact, fissile ("platy") structure and containing coarse fragments oriented with their long axes generally parallel to the direction of ice movement. Compare - till, flow-till, melt-out till. GG

loess - Material transported and deposited by wind and consisting predominantly of silt-size particles. Commonly a loess deposit thins and the mean-particle size decreases as distance from the source area increases. Loess sources are dominantly from either glacial meltwaters (i.e. "cold loess") or from non-glacial, arid environments, such as deserts (i.e. "hot loess"). [soil survey] Several types of loess deposits can be recognized based on mineralogical composition (calcareous loess, non-calcareous loess). SW & GSST

loess bluff - A bluff composed of a thick deposit of coarse loess, formed immediately adjacent to the edges of flood plains, as along the Mississippi River valley or China. Sometimes referred to as a bluff formation (not preferred). SW & GG.

loess hill - A hill composed of thick deposits of loess, as in IA, MO, NE and the Palouse Hills of WA & ID. SW

log landing – A comparatively level area, usually with road access, constructed or cut into steeper slopes and used for sorting logs during timber harvest operations. Compare – skid trail. SW

longitudinal dune – A long, narrow sand dune, usually symmetrical in cross profile, oriented parallel to the prevailing wind direction ; it is wider and steeper on the windward side but tapers to a point on the lee side. It commonly forms behind an obstacle in an area where sand is abundant and the wind is strong and constant. Such dunes can be a few meters high and up to 100 km long. Compare – seif dune, transverse dune. GG

long run-out landslide – (not recommended; see rockfall avalanche).

longshore bar [relict] - A narrow, elongate, coarse-textured ridge that once rose near to, or barely above, a pluvial or glacial lake and extended generally parallel to the shore but was separated from it by an intervening trough or lagoon; both the bar and lagoon are now relict features. GG

louderback - A hill or ridge composed of a lava flow remnant that caps or is exposed in a tilted fault block and bounded by a dip slope. Used as evidence of block faulting in Basin-and-Range terrain (western USA). Compare – hogback. GG

low-center polygon - A polygon whose center is depressed relative to its boundary. Compare - high-center polygon. NRC

low hill – A generic name for an elevated, generally rounded land surface with low local relief, rising between 30 meters (100 ft.) to as much as 90 m (approx. 300 ft.) above surrounding lowlands. Compare – high hill, hill, hillock. SW

lowland - (a) An informal, generic, imprecise term for low-lying land or an extensive region of low-lying land, especially near a coast and including the extended plains or country lying not far above tide level. (b) (not preferred) A generic, imprecise term for a landscape of low, comparatively level ground of a region or local area, in contrast with the adjacent higher country. (c) (not recommended – use valley, bolson, etc.) A generic term for a large valley. Compare - upland. SW

low marsh - (refer to mud flat). The flat, usually bare ground situated seaward of a salt marsh and regularly covered and uncovered by the tide; e.g., a mud flat. GG

lowmoor bog - A bog that is at or only slightly above the water table, on which it depends for accumulation and preservation of peat (chiefly the remains of sedges, reeds, shrubs, and various mosses). Compare - highmoor bog, raised bog. GG

maar – A low relief, broad volcanic crater formed by multiple, shallow explosive eruptions. It is surrounded by a crater ring in the form of low ramparts of gently dipping (i.e. < 25 degrees), well-bedded ejecta; may be partially or completely filled by water (*maar lake*). SW & GG

mafic rock - A general term for igneous rock composed chiefly of one or more ferromagnesian, dark-colored minerals; also said of those minerals. Compare - felsic rock. GG

mainland cove - A subaqueous area adjacent to the mainland or a submerged mainland beach that forms a minor recess or embayment within the larger basin. Compare – cove, barrier cove. SSS

main scarp - The steep surface on undisturbed ground at the upper edge of a landslide, caused by movement of displaced material away from the undisturbed ground; it is visible a part of the surface of rupture (slip surface). Compare – minor scarp, toe. CV & SW

mangrove swamp - A tropical or subtropical marine swamp formed in a silty, organic, or occasionally a coralline substratum and characterized by abundant mangrove trees along the seashore in a low area of salty or brackish water affected by daily tidal fluctuation but protected from violent wave action by reefs or land; dominated by saturated soils, commonly sulfaquents. SW & GG

marine deposit - Sediments (predominantly sands, silts and clays) of marine origin; laid down in the waters of an ocean. Compare - estuarine deposit, lagoonal deposit. SW

marine lake [water] - An inland body of permanently standing brackish or saline water, occupying a depression on the Earth's surface whose water level is commonly influenced by ocean tides through subterranean cavities connecting to nearby lagoons; generally of appreciable size (larger than a pond) and too deep to permit emergent vegetation to take root completely across the expanse of water. Such water bodies can have unique biota (e.g. sting-less jellyfish of Palau). SW

marine terrace - A constructional coastal strip, sloping gently seaward, veneered by marine deposits (typically silt, sand, fine gravel). Compare - terrace, wave-built terrace. GG

marl - A generic term loosely applied to a variety of materials, most of which occur as an earthy, unconsolidated deposit consisting chiefly of an intimate mixture of clay and calcium carbonate formed commonly by the chemical action of algae mats and organic detritus (periphyton); specifically an earthy substance containing 35 - 65 % clay and 65-35% calcium carbonate mud ; formed primarily under freshwater lacustrine conditions, but varieties associated with more saline environments and higher carbonate contents also occur. Compare – coastal marl, freshwater marl, SW & HP

marsh - Periodically wet or continually flooded areas with the surface not deeply submerged. Covered dominantly with sedges, cattails, rushes, or other hydrophytic plants. Compare - salt marsh, swamp, bog, fen. GSST

mass movement - A generic term for any process or sediments (mass movement deposit) resulting from the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress. The process includes slow displacements such as creep and solifluction, and rapid movements such as landslides, rock slides, and falls, earthflows, debris flows, and avalanches. Agents of fluid transport (water, ice, air) may play an important, if subordinate role in the process. HP

mass-movement till - (not preferred) refer to "till"

mass wasting - (not preferred) refer to mass movement.

mawae - (colloquial: Hawaii) A natural surface channel commonly found near the middle of an a'a lava flow, formed by the surficial draining of molten lava rather than by erosion from running water; a type of lava trench. Compare - lava tube. MA

meander [streams] - One of a series of regular freely developing sinuous curves, bends, loops, turns, or windings in the course of a stream. GG.

meander belt - The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops. Landform components of the meander-belt surface are produced by a combination of gradual (lateral and down-valley) migration of meander loops and avulsive channel shifts causing abrupt cut-offs of loop segments. Landforms flanking the sinuous stream channel include: point bars, abandoned meanders, meander scrolls, oxbow lakes, natural levees, and flood-plain splays. Meander belts may not exhibit prominent natural levee or splay forms. Flood plains of broad valleys may contain one or more abandoned meander belts in addition to the zone flanking the active stream channel. HP

meandering channel - The term "meandering" should be restricted to loops with channel length more than 1.5 to 2 times the meander wave length. Meandering stream channels commonly have cross sections with low width-to-depth ratios, cohesive (fine-grained) bank materials, and low gradient. At a given bank-full discharge, meandering streams have gentler slopes, and deeper narrower, and more stable channel cross sections than braided streams. Compare - meander, braided stream, flood-plain landforms. HP & RR

meander scar - (a) A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream which impinged upon and undercut the bluff; if it's no longer adjacent to the modern stream channel it indicates an abandoned route of the stream. SW; (b) (not recommended – refer to oxbow) An abandoned meander, commonly filled in by deposition and vegetation, but still discernable. GG

meander scroll - (a) One of a series of long, parallel, close fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank. Compare - meander belt, point bar. (b) (not recommended; refer to oxbow lake) - A small, elongate lake on a flood plain in a well-defined part of an abandoned stream channel. GG

medial moraine - (a) An elongate moraine carried in or upon the middle of a glacier and parallel to its sides, usually formed by the merging of adjacent and inner lateral moraines below the junction of two coalescing valley glaciers. (b) A moraine formed by glacial abrasion of a rocky protuberance near the middle of a glacier and whose debris appears at the glacier surface in the ablation area. (c) The irregular ridge left behind in the middle of a glacial valley, when the glacier on which it was formed has disappeared. GG

melt-out till - Till derived from slow melting of debris-rich stagnant ice buried beneath sufficient overburden to inhibit deformation under gravity, thus preserving structures derived from the parent ice. Compare - flow-till, lodgment till. GG

mesa - A broad, nearly flat-topped, and usually isolated landmass bounded by steep slopes or precipitous cliff and capped by layers of resistant, nearly horizontal, rocky summit width greater than the height of bounding escarpments. (Colloquial: western USA; not preferred) Also used to designate broad structural benches and alluvial terraces that occupy intermediate levels in stepped sequences of platforms bordering canyons and valleys. Compare - butte, plateau, cuesta. HP & GG

metamorphic rock - Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline. Examples: schist, gneiss, quartzite, slate, marble. HP

metasediment - A sediment or sedimentary rock that shows evidence of having been subjected to metamorphism. GG

meta-stable slope - (not recommended)

meteorite crater – An impact crater formed by the falling of a large meteorite onto the earth's surface; e.g., Barringer Crater (AZ). Compare – crater, impact crater. SW & GG

microbiotic crust - A thin, surface layer (crust) of soil particles bound together primarily by living organisms and their organic byproducts; thickness can range up from < 1 cm up to 10 cm; aerial coverage of the ground surface can range from 10 - 100%. Crusts stabilize loose earthy material. Other types of surface crusts include chemical crusts (e.g., salt crusts) and physical crusts (e.g., raindrop-impact crust). SW & SS

micro-depression - (not preferred) refer to microlow.

microfeature [soil survey] - Small, local, natural forms (features) on the land surface that are too small to delineate on a topographic or soils map at commonly used map scales (e.g. 1:24,000 to 1:10,000). Examples include earth pillar, patterned ground, frost boil. Compare - microrelief. SW

microhigh - A generic microrelief term applied to slightly elevated areas relative to the adjacent ground surface; changes in relief range from several centimeters to several meters; cross-sectional profiles can be simple or complex and generally consist of gently rounded, convex tops with gently sloping sides; also spelled *micro-high*. SW.

micro-knoll - (not preferred) refer to microhigh.

microlow- A generic microrelief term applied to slightly lower areas relative to the adjacent ground surface (e.g. shallow depression); changes in relief range from several centimeters to several meters; cross-sectional profiles can be simple or complex and generally consist of subdued, concave, open or closed depressions with gently sloping sides; also spelled *micro-low*. SW.

microrelief - (a) [soil survey] Slight variations in the height of a land surface that are too small or intricate to delineate on a topographic or soils map at commonly used map scales (e.g. 1:24,000 through 1:10,000). Examples include microhigh, microlow. Compare - microfeature. SW (b) (not preferred - refer to microfeature) Generically refers to local, slight irregularities in form and height of a land surface that are superimposed upon a larger landform, including such features as low mounds, swales, and shallow pits. GG

midden - A mound or stratum of refuse (broken pots, ashes, food remains, etc.) normally found on the site of an ancient settlement. GG

mima mound - A term used for one of numerous low circular or oval domes composed of loose, unstratified, gravelly, silty, or sandy material. The basal diameter varies from 3 meters to more than 30 meters, and the height from 30 centimeters to about 2 meters. Compare - pimple mound, patterned ground, shrub-coppice dune. GG

mine spoil, coal extraction – Randomly mixed, earthy materials artificially deposited as a result of either surficial or underground coal mining activities; a type of mine spoil. SW

mine spoil, metal-ore extraction – Randomly mixed, earthy materials artificially deposited as a result of either surficial or underground metal-ore mining activities; a type of mine spoil. SW

mine spoil or earthy fill [soil survey] - An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. SW & GSST

minor scarp – A steep surface on the displaced material of a landslide, produced by differential movements within the sliding mass. Compare – main scarp, toe. CV

Miocene - The epoch of the Tertiary Period of geologic time (from approximately 5.2 million to 23 million years ago), immediately following the Oligocene Epoch and preceding the Pliocene Epoch; also corresponding (time-stratigraphic) "series" of earth materials. HP

mogote – (colloquial: Caribbean Basin) An isolated, steep-sided, commonly asymmetrical hill or ridge composed of limestone, generally steeper on its leeward side (prevailing downwind side) and surrounded by nearly level to sloping coastal plain composed of marine and alluvial sediments; a type of karst tower. They range in height from a few feet (< 1 m) to over 150 ft (50 m). Most are isolated and cover small areas but some form clusters of hills or ridges rising out of the surrounding blanket deposits. Mogotes are extensive in northern Puerto Rico. SW, Monroe (1976, 1980), & WW.

monadnock - An isolated hill or mountain of resistant rock rising conspicuously above the general level of a lower erosion surface in a temperate climate representing an isolated remnant of a former erosion cycle in an area that has largely been beveled to its base level. Compare - inselberg, nunatak. GG

monocline - (a) [landform] A unit of folded strata that dips from the horizontal in one direction only, is not part of an anticline or syncline, and occurs at the earth's surface.. This structure is typically present in plateau areas where nearly flat strata locally assume steep dips caused by differential vertical movements without faulting. Compare - anticline, syncline, fold. SW & HP (b) [structural geology]- A local steepening in an otherwise uniform gentle dip. GG

moraine [glacial geology] - (a) [material] A mound, ridge, or other topographically distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited primarily by the direct action of glacier ice, in a variety of landforms. (b) [landform] A general term for a landform composed mainly of till that has been deposited by a glacier; a kame moraine is a type of moraine similar in exterior form to other types of moraines but composed mainly of stratified outwash materials. Types of moraine include: disintegration, end, ground, kame, lateral, recessional, and terminal. SW

mossy organic materials - see organic materials

moss peat [Soil Taxonomy] - An accumulation of organic material that is predominantly the remains of mosses (e.g. sphagnum moss). Compare - Herbaceous peat, sedimentary peat, woody peat, peat, muck, and mucky peat. SSM

mound - (a) A low, rounded natural hill of unspecified origin, generally < 3 m high and, composed of earthy material; (b) A small, human-made hill, composed either of debris accumulated during successive occupations of the site (e.g. tell) or of earth heaped up to mark a burial site (e.g. burial mound). (c) A structure built by colonial organisms (e.g. termite mound). GG

mountain - A generic term for an elevated area of the land surface, rising more than 300 meters above surrounding lowlands, usually with a nominal summit area relative to bounding slopes and generally with steep sides (greater than 25 percent slope) with or without considerable bare-rock exposed. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by tectonic activity and/or volcanic action and secondarily by differential erosion. Compare - hill, hillock, plateau, foothills, mountains. SW & HP

mountainbase - A geomorphic component of mountains consisting of the lowermost area, consisting of the strongly to slightly concave colluvial apron or wedge at the bottom of mountain slopes; composed of long-transport colluvium and slope alluvium sediment. It can extend out onto more level valley areas where it ultimately interfingers with, is buried by alluvium or is replaced by re-emergent residuum. Compare - mountaintop, mountainflank, free face, geomorphic component. SW

mountainflank - A geomorphic component of mountains consisting of the side area of mountains, characterized by very long, complex backslopes with comparatively high slope gradients and composed of highly-diverse, colluvial sediment mantles, complex near-surface hydrology, mass movement processes and features (e.g., creep, landslides); rock outcrops or structural benches may be present. The mountainflank can be subdivided by the general location along the mountainside (i.e., upper third, middle third, or lower third mountainflank). Compare - mountaintop, mountainbase, free face, geomorphic component. SW

mountain range – A single, large mass consisting of a succession of mountains or narrowly spaced mountain ridges, with or without peaks, closely related in position, direction, orientation, formation, and age; a component part of a mountain system. Compare – mountain system, mountains. GG

mountains – A region or landscape characterized by mountains and their intervening valleys; a generic name for any group, cluster, or sequence of mountains or narrowly spaced mountain ridges, with or without peaks, closely related in position, orientation, direction, formation, or age, and whose summits commonly exceed 300 m (approx. 1000 ft). Compare – foothills, hills, mountain range, mountain system. SW.

mountainside - (not recommended) use mountain slope.

mountain slope - A part of a mountain between the summit and the foot. Compare – mountainflank, hillslope. GG

mountain system – A group of mountain ranges exhibiting certain unifying features, such as similarity in form, structure and alignment, and presumably originating from the same general causes; especially a series of mountain ranges belonging to an orogenic belt. Compare – mountain range, mountains. GG

mountaintop - A geomorphic component of mountains consisting of the uppermost, comparatively level or gently sloped area of mountains, characterized by relatively short, simple slopes composed of bare rock, residuum, or short-transport colluvial sediments. In humid environments, mountaintop soils can be quite thick and well developed. Compare - mountainflank, mountainbase, free face, geomorphic component. SW

mountain valley - (a) Any small, externally drained V-shaped depression (in cross-section) cut or deepened by a stream and floored with alluvium, or a broader, U-shaped depression modified by an alpine glacier and floored with either till or alluvium, that occurs on a mountain or within mountains. Several types of mountain valleys can be recognized based on their form and valley floor sediments (i.e., *V-shaped valley*, *U-shaped valley*). Compare – valley. SW (b) (colloquial: Basin and Range, USA) A relatively small, structural depression within a mountain range that is partly filled with alluvium and commonly drains externally to an intermontane basin, bolson, or semi-bolson. Compare - valley flat. SW & FFP

muck - Unconsolidated soil material consisting primarily of highly decomposed organic material in which the original plant parts are not recognizable (i.e. "sapric" in Soil Taxonomy). It generally contains more mineral matter and is usually darker in color, than peat. Compare - peat, mucky peat, herbaceous peat. GSST

mucky peat - Unconsolidated soil material consisting primarily of organic matter that is in an intermediate stage of decomposition such that a significant part of the original material can be recognized and a significant part of the material can not be recognized (i.e. "hemic" in Soil Taxonomy). Compare - peat, muck, herbaceous peat. SSM

mud flat – **(not preferred – use tidal flat)** A relatively level area of fine grained material (e.g. silt) along a shore (as in a sheltered estuary) or around an island, alternately covered and uncovered by the tide or covered by shallow water, and barren of vegetation. Compare – low marsh, tidal flat, tidal marsh. GG

mudflow [mass movement] – The process, associated sediments (mudflow deposit) or resultant landform characterized by a very rapid type of *earthflow* dominated by a sudden, downslope movement of a saturated mass of rock, soil, and mud (more than 50 % of the particles are < 2 mm), that behaves as much as a viscous fluid when moving. Compare – debris flow, flow, landslide. SW & DV

mud pot – A type of hot spring containing boiling mud, usually sulfurous and often multicolored, as in a paint pot. Mud pots are commonly associated with geysers and other hot springs in volcanic areas, especially in Yellowstone Natl. Park, WY. Compare – geyser, hot spring. GG

mudstone - (a) A blocky or massive, fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal; (b) A general term that includes clay, silt, claystone, siltstone, shale, and argillite, and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified. GG

muskeg - A bog, usually a sphagnum bog, frequently with grassy tussocks (hummocks), growing in wet, poorly drained boreal regions, with deep accumulations of organic material, often in areas of permafrost; a moss-covered muck or peat bog of boreal regions. GG and HP

natural levee - A long, broad low ridge or embankment of sand and coarse silt, built by a stream on its flood plain and along both sides of its channel, especially in time of flood when water overflowing the normal banks is forced to deposit the coarsest part of its load. It has a gentle slope away from the river and toward the surrounding floodplain, and its highest elevation is closest to the river bank. Compare - levee, artificial levee, meander belt. GG

neck [volcanic] – A vertical, pipe-like tower of solidified lava or consolidated fragmental igneous rock that represents a former volcanic vent whose surrounding material (e.g. tuff and tephra) has been largely removed by erosion. Compare – plug [volcanic], diatreme. SW, GG, & GS

net (nonsorted) - (not preferred) refer to patterned ground.

net (sorted) - (not preferred) refer to patterned ground.

nivation - The process of excavation of a shallow depression or nivation hollow on a mountain side by removal of fine material around the edge of a shrinking snow patch or snow bank, chiefly through sheetwash, rivulet flow, and solution in melt water. Freeze-thaw action is apparently insignificant. GG

nivation hollow – A shallow, non-cliffed depression or hollow on a mountain side permanently or intermittently occupied by a snow bank or snow patch and produced by nivation. If the snow completely melts each summer the hollow is deepened; otherwise not; may be a cirque precursor if further enlarged and deepened by alpine glaciation. GG

nonsorted circle - A type of patterned ground whose mesh (shape) is dominantly circular and has a nonsorted appearance due to the absence of a boarder of coarse fragments. Vegetation characteristically outlines the pattern by forming a bordering ridge. Diameters commonly range from 0.5 to 3 m. Nonsorted circles include mud boils, earth hummocks, turf hummocks, and frost boils. Nonsorted circles have various origins. Some, such as mud and earth hummocks and frost boils, involve cryoturbation activity and differential heave of frost-susceptible materials. Others, such as mud boils, involve hydraulic pressures and diapir-like displacement of water-saturated sediments. Compare - sorted circle, frost boil, patterned ground. NRC and GG

nonsorted polygon - (not preferred) refer to patterned ground.

nose slope [geomorphology] - A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside, resulting in predominantly divergent overland water flow (e.g., sheet wash); contour lines generally form convex curves. Nose slopes are dominated by colluvium and slope wash sediments (e.g., slope alluvium). Slope complexity (downslope shape) can range from simple to complex. Nose slopes are comparatively drier portions of hillslopes and tend to have thinner colluvial sediments and profiles. Compare - head slope, side slope, free face, interfluve, crest, base slope. SW

notch - (a) (colloquial - northeast USA) A narrow passageway, or short defile between mountains; a deep, close pass. Compare - gap. (b) A breached opening in the rim of a volcanic crater. GG

nuée ardente - A swiftly flowing, turbulent gaseous cloud, sometimes incandescent, erupted from a volcano and containing ash and other pyroclastics in its lower part; a density current of pyroclastic flow. Compare - lahar. GG

nunatak - An isolated hill, knob, ridge, or peak of bedrock that projects prominently above the surface of a glacier and is completely surrounded by glacier ice. Compare - inselberg, monadnock. GG

ocean – The continuous salt-water body that surrounds the continents and fills the Earth's great depressions; also, one of its major geographic divisions. Compare – sea. GG

offshore bar - (not recommended) use barrier beach.

Oligocene - The epoch of the Tertiary Period of geologic time (from 23.3 to 35.4 million years ago), following the Eocene Epoch and preceding the Miocene Epoch; also the corresponding (time-stratigraphic) "series" of earthy materials. SW

open depression – A generic name for any enclosed or low area that has a surface drainage outlet whereby surface water can leave the enclosure; an area of lower ground indicated on a topographic map by contour lines forming an incomplete loop or basin indicating at least one surface exit. Compare – closed basin. SW

openpit mine – A relatively large depression resulting from the excavation of material and redistribution of overburden associated with surficial mining operations. Compare – quarry, surface mine. SW & GG

organic materials - [soil survey] Unconsolidated sediments or deposits in which carbon is an essential, substantial component. Several types of organic materials (deposits) can be identified based on the composition of the dominant fibers (grassy organic materials, herbaceous organic materials, mossy organic materials, woody organic materials). Compare - herbaceous peat, moss peat, sedimentary peat, woody peat. SW

outcrop - (a) That part of a geologic formation or structure that appears at the surface of the earth. (b) [soil survey] An actual exposure of bedrock at or above the ground surface. Compare - cliff. SW & GG

outwash [glacial geology] - Stratified and sorted sediments (chiefly sand and gravel) removed or "washed out" from a glacier by melt-water streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice. Compare - pitted outwash, drift, esker, kame, till. SW & GG

outwash delta – A relict (inactive) delta composed of glaciofluvial sediments formed where a sediment laden outwash river emptied into an open lake, commonly a proglacial lake. Sediment attributes include very gently dipping topset beds (coarser textures) and steeply dipping foreset beds (finer textures). SW & GM

outwash fan - A fan-shaped accumulation of outwash deposited by meltwater streams in front of the end or recessional moraine of a glacier. Coalescing outwash fans form an outwash plain. GG

outwash plain - An extensive lowland area of coarse textured, glaciofluvial material. An outwash plain is commonly smooth; where pitted, due to melt-out of incorporated ice masses (pitted outwash plain), it is generally low in relief and largely retains it's original gradient. Compare - outwash, pitted outwash plain, collapsed outwash plain, kettles; also called sandur. SW & HP

outwash terrace - A flat-topped bank of outwash with an abrupt outer face (scarp or riser) extending along a valley downstream from an outwash plain or terminal moraine; a valley train deposit. Compare - kame terrace, valley train. SW

overbank deposit - Fine-grained sediments (silt and clay) deposited from suspension on a flood plain by floodwaters that cannot be contained within the stream channel. GG

overburden - (a) The upper part of a sedimentary deposit, compressing and consolidating the materials below. (b) The loose soil or other unconsolidated material overlying bedrock, either transported or formed in place (synonym for regolith). GG

overflow stream channel – A watercourse that is generally dry but conducts flood waters that have overflowed the banks of a river, commonly from large storms, annual meltwater, or glacial meltwaters. SW

overprinting – The process of superimposing a new set of features over a preexisting set due to a shift in environmental conditions such as a change in climate or local hydrology. The resulting composite morphology retains features that would not form under present conditions. Compare – overprinted soil. SW

overprinted soil - A soil in which new soil morphology has developed and is superimposed upon that of a pre-existing soil due to a shift in pedogenic conditions such as a change in climate or hydrology; the composite morphology retains some relict features that would not form under present day conditions. (not preferred) Sometimes called welded soil. SW.

overthrust - A low angle thrust fault of large scale, with displacement generally measured in kilometers. GG

oxbow - A closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream. (colloquial: northeastern U.S.A.) the land enclosed, or partly enclosed, within an oxbow. Compare - meander belt, oxbow lake, bayou. GG

oxbow lake - The crescent-shaped, often ephemeral body of standing water situated by the side of a stream in the abandoned channel (oxbow) of a meander after the stream formed a neck cutoff and the ends of the original bend were silted up. Compare - meander belt, oxbow. GG

paha - (colloquial: Midwestern USA) Commonly a low, elongated, rounded ridge or hill cored by an erosional remnant of drift, rock, or windblown sand, silt, or clay and capped with a thick cover (e.g. up to 10 m) of loess; found especially in northeast Iowa. Height varies between 10 and 30 m. SW & GG

pahoehoe lava - A type of basaltic lava (material) with a characteristically smooth, billowy or rope-like surface and vesicular interior. Compare - \`a\`a lava, block lava, pillow lava. GG & MA

pahoehoe lava flow- A type of basaltic lava flow with a characteristically smooth, billowy or rope-like surface. Compare - \`a\`a lava flow, block lava flow, pillow lava flow. GG & MA

Paleocene - The earliest epoch of the Tertiary Period of geologic time (from 56.5 to 65.0 million years ago), immediately following the Cretaceous Period and preceding the Eocene Epoch; also corresponding (time-stratigraphic) "series" of earthy materials. SW

paleosol - A soil that formed on a landscape in the past with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial. A paleosol (or component horizon) may be classed as relict if it has persisted in a land-surface position without major alteration of morphology by processes of the prevailing pedogenic environment. An exhumed paleosol is one that formerly was buried and has been re-exposed by erosion of the covering mantle. Most paleosols have been affected by some subsequent modification of diagnostic horizon morphologies and profile truncation. HP

paleoterrace - An erosional remnant of a terrace which retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to a present-day stream or drainage network. Compare - alluvial plain remnant. SW

palsa - An elliptical dome-like permafrost mound containing alternating layers of ice lenses and peat or mineral soil, commonly 3-10 m high and 2-25 m long, occurring in subarctic bogs of the tundra and often surrounded by water; pl. palsen. NRC

parabolic dune - A sand dune with a long, scoop-shaped form, convex in the downwind direction so that its horns point upwind, whose ground plan, when perfectly developed, approximates the form of a parabola. GG

parallel drainage pattern - A drainage pattern in which the streams and their tributaries are regularly spaced and flow parallel or subparallel to one another and tributaries characteristically join the mainstream at approximately the same angle, over a considerable area. It is indicative of a region having a pronounced, uniform slope and a homogeneous lithology and rock structure, such as young coastal plains and large basalt flows. SW, GG, WA

parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which a soil's solum is developed by pedogenic processes. GSST

park – (colloquial – Rocky Mountains, USA; not preferred – refer to valley, intermontane basin) (a) An ecological term for a grassy or shrubby, wide, open valley lying at high elevation and confined between forested mountain slopes, as in a high meadow; sometimes marshy. Compare – glade. (b) (refer to intermontane basin) A level valley between mountain ranges. GG & SW

parna - A term used, especially in southeast Australia and southwestern USA, for silt and sand-sized aggregates of eolian clay occurring as sheets or dunes. Compare - parna dune. SW & GG

parna dune - A dune largely composed of silt and sand-sized aggregates of clay; sometimes called a clay dune or lunette. Compare - parna. HP

partial ballena - (not preferred) refer to ballena

patina - A general term for a colored film or thin outer layer produced on the surface of a rock or other material by weathering after long exposure. Compare - rock varnish. GG

patterned ground - A general term for any ground surface exhibiting a discernibly ordered, more-or-less symmetrical, morphological pattern of ground and, where present, vegetation. Patterned ground is characteristic of, but not confined to, permafrost regions or areas subjected to intense frost action; it also occurs in tropical, subtropical, and temperate areas. Patterned ground is classified by type of pattern and presence or absence of sorting and includes nonsorted and sorted circles, net, polygons, steps and stripes, garlands, and solifluction features. In permafrost regions, the most common macroform is the ice-wedge polygon and a common microform is the nonsorted circle. Stone polygons generally form on slopes of less than 8 percent, while garlands and stripes occur on slopes of 8 to 15 percent and more than 15 percent, respectively. NRC and HP

pavement karst – Areas of bare limestone, usually sculpted by solution erosion into karren of various types and where soils have been stripped off, commonly by glaciation in alpine areas (e.g. Rocky Mountains – USA) and high latitudes, and by water erosion in arid karst areas. Compare – fluviokarst, glaciokarst, sinkhole karst, karst. SW & WW

peak - Sharp or rugged upward extension of a ridge chain, usually at the junction of two or more ridges; the prominent highest point of a summit area. HP

peat - Unconsolidated soil material consisting largely of undecomposed, or slightly decomposed, organic matter (i.e. "fibric" in Soil Taxonomy) accumulated under conditions of excessive moisture. Compare - muck, mucky peat, herbaceous peat. GSST

peat plateau - A generally flat-topped expanse of peat, elevated above the general surface of a peatland, and containing segregated ice that may or may not extend downward into the underlying mineral soil. Controversy exists as to whether peat plateaus and palsen are morphological variations of the same feature. NRC

pediment - A gently sloping erosional surface developed at the foot of a receding hill or mountain slope, commonly with a slightly concave-upward profile, that cross-cuts rock or sediment strata that extend beneath adjacent uplands. The erosion surface may be essentially bare bedrock (i.e. *rock pediment*), or it may be thinly mantled (e.g. 1 to 3 m) with debris (i.e. *pediment*) such as colluvium, pedisediment, or alluvium that is ultimately in transit from an upland front to basin or valley lowland. In hill-footslope terrain the debris mantle (over an erosional contact) is designated "pedisediment." The term has been used in several geomorphic contexts: Pediments may be classed with respect to (a) landscape positions (e.g. intermontane-basin piedmont = *apron pediment*, or valley-border footslope surfaces (= *terrace pediment*); Cooke and Warren, 1973); (b) type of material eroded (e.g. bedrock = *rock pediment*, or regolith = *pediment*); or (c) combinations of the above. Compare – rock pediment, Piedmont slope, structural bench. SW, HP, RR

pedisediment - A layer of sediment, eroded from the shoulder and back slope of an erosional slope, that lies on and is, or was, being transported across a pediment. FFP

pedoturbation - The mixing of soil materials by natural processes. Compare - cryoturbation. BHM

peneplain - (not recommended; obsolete) A low nearly featureless, gently undulating land surface of considerable area, which presumably has been produced by the processes of long-continued subaerial erosion. GG

peninsula – (a) An elongated body or stretch of land nearly surrounded by water (e.g., on three sides) and connected with a larger tract of land area, usually by a neck or an isthmus. (b) A relatively large tract of land jutting out into the water, with or without a well-defined isthmus; e.g., the Italian peninsula. GG

perennial stream - A stream or reach of a stream that flows continuously throughout the year and whose surface is generally lower than the water table adjacent to the region adjoining the stream. Compare - Ephemeral stream, Intermittent stream. GG

periglacial - (adjective) Pertaining to processes, conditions, areas, climates, and topographic features occurring at the immediate margins of glaciers and ice sheets, and influenced by cold temperature of the ice. The term was originally introduced to designate the climate and related geologic features peripheral to ice sheets of the Pleistocene. HP

permafrost - Ground, soil, or rock that remains at or below 0^{o} C for at least two years. It is defined on the basis of temperature and is not necessarily frozen. Compare - continuous permafrost, discontinuous permafrost, sporadic permafrost, thaw-stable permafrost, thaw sensitive permafrost. NRC

physiographic province - A region of which all parts are similar in geologic structure and climate and which has consequently had a unified geomorphic history; a region whose pattern of relief or landforms differ significantly from that of adjacent regions. Examples: the Valley and Ridge, Blue Ridge, and Piedmont provinces in the eastern U.S.A., and the Basin and Range, Rocky Mountains, and Great Plains provinces in the western U.S.A. **GG**

piedmont - (adjective) Lying or formed at the base of a mountain or mountain range; e.g., a piedmont terrace or a piedmont pediment. (noun) An area, plain, slope, glacier, or other feature at the base of a mountain; e.g., a foothill or a bajada. In the United States, the Piedmont (noun) is a low plateau extending from New Jersey to Alabama and lying east of the Appalachian Mountains. GG

piedmont slope – (colloquial – western USA) The dominant gentle slope at the foot of a mountain; generally used in terms of intermontane-basin terrain in arid to subhumid regions. Main components include: (a) An erosional surface on bedrock adjacent to the receding mountain front (pediment, rock pediment); (b) A constructional surface comprising individual alluvial fans and interfan valleys, also near the mountain front; and (c) A distal complex of coalescent fans (bajada), and alluvial slopes without fan form. Piedmont slopes grade to basin-floor depressions with alluvial and temporary lake plains or to surfaces associated with through drainage (e.g., axial streams). Compare – bolson, fan piedmont. HP

pillow lava – A general term for lava displaying pillow structure (discontinuous, close-fitting, bun-shaped or ellipsoidal masses, generally < 1 m in diameter); considered to have formed in a subaqueous environment; such lava is usually basaltic or andesitic. Compare – \`a\`a lava, block lava, pahoehoe lava. SW, GG, & GS

pillow lava flow – A lava flow or body displaying pillow structure and considered to have formed in a subaqueous environment (underwater); usually basaltic or andesitic in composition. Compare – \`a\`a lava flow, block lava flow, pahoehoe lava flow. SW & GS

pimple mound - (colloquial: Gulf Coast U.S.A.) Low, flattened, approximately circular or elliptical features composed of sandy loam that is coarser than, and distinct from, the surrounding soil; the basal diameter ranges from 3 m to more than 30 m, and the height from 30 cm to more than 2 m. Compare - mima mound, patterned ground, shrub-coppice dune. GG

pingo - A large frost mound; especially a relatively large conical mound of soil-covered ice (commonly 30 to 50 meters high and up to 400 meters in diameter) raised in part by hydrostatic pressure within and below the permafrost of Arctic regions, and of more than 1 year's duration. GG

pinnacle [geomorphology] - A tall, slender, tapering tower or spire-shaped pillar of rock, either isolated, as on steep slopes or cliffs formed in karst or other massive rocks, or at the summit of a hill or mountain. Compare - erosional remnant, hoodoo. SW, GG, & WW

pinnate drainage pattern – A variation of the dendritic drainage pattern in which the main stream receives many closely spaced, subparallel tributaries that join it at slightly acute angles upstream, resembling in plan a feather. They typically form on steep slopes with soils that have a high silt content; such as loess landscapes or fine-textured flood plains. SW, GG, WA

pit and mound topography – (not recommended) use tree-tip pit and mound topography.

pitted outwash - Outwash deposits with surficial pits or kettles, produced by the partial or complete burial of glacial ice by outwash and the subsequent thaw of the ice and collapse of the surficial materials. Compare - pitted outwash plain. GG

pitted outwash plain - An outwash plain marked by many irregular depressions such as kettles, shallow pits, and potholes which formed by melting of incorporated ice masses; much of the gradient and internal structures of the original plain remain intact; many are found in WI, MN, MI, and IN. Compare – collapsed outwash plain, outwash, pitted outwash. GG

pitted outwash terrace – A relict glaciofluvial terrace that retains its original attitude, composed of undistorted outwash sediments and depositional structures and whose surface is pock-marked with numerous potholes or kettle depressions. Compare – collapsed outwash plain. SW

plain - A general term referring to any flat, lowland area, large or small, at a low elevation. Specifically, any extensive region of comparatively smooth and level gently undulating land. A plain has few or no prominent hills or valleys but sometimes has considerable slope, and usually occurs at low elevation relative to surrounding areas. Where dissected, remnants of a plain can form the local uplands. A plain may be forested or bare of trees and may be formed by deposition or erosion. Compare - lowland, plateau. GG

plateau - [geomorphology] A comparatively flat area of great extent and elevation; specifically an extensive land region considerably elevated (more than 100 meters) above adjacent lower-lying terrain, and is commonly limited on at least one side by an abrupt descent, has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level. Compare - hill, foothill, mountain, mesa, plain. GG

playa - The usually dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those occurring on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation-runoff events. Playa deposits are fine grained and may or may not have high water table and saline conditions. HP

playa dune – (colloquial – Southern High Plains) A linear or curvilinear ridge of windblown, granular material (generally sand or parna) removed from the adjacent basin by wind erosion (deflation), and deposited on the leeward (prevailing downwind) margin of a playa, playa basin, or salina basin. The dune may be barren or vegetated. Compare – dune. SW

playa floor – (colloquial – Southern High Plains) The lowest extensive, flat to slightly concave surface within a playa basin, consisting of a dry lake bed or lake plain underlain by stratified clay, silt or sand, and commonly by soluble salts. Compare – playa step. SW

playa lake - A shallow, intermittent lake in a arid or semi-arid region, covering or occupying a playa in the wet season but drying up in summer; an ephemeral lake that upon evaporation leaves or forms a playa. GG

playa rim – (colloquial – Southern High Plains) The convex, upper margin (shoulder) of a playa basin where the playa slope intersects the surrounding terrain. Compare – playa slope. SW

playa slope – (colloquial – Southern High Plains) The generally concave to slightly convex area within a playa basin that lies between the relatively level playa floor below (or playa step, if present) and the convex playa rim above. Overland flow is typically parallel down slope. Compare – playa step, playa rim. SW

playa step – (colloquial – Southern High Plains) The relatively level or gently inclined "terrace-like" bench or toeslope within a large playa basin flanking and topographically higher than the playa floor and below the playa slope; a bench or step-like surface within a playa basin that breaks the continuity of the playa slope and modified by erosion and/or deposition. Temporary ponding may occur in response to precipitation / runoff events. Compare – playa slope. SW

playette – A very small, playa-like, shallow, closed depression typically with a salt-encrusted surface, little or no vegetation in semi-arid to arid climates and infrequently subject to ponding from precipitation events; commonly lacks the component parts of a playa except for a small *playa floor*. Compare – playa. SW & GHG

Pleistocene - The epoch of the Quaternary Period of geologic time (from about 10 to 12 thousand to 1.6 million years ago), following the Pliocene Epoch and preceding the Holocene also the corresponding (time-stratigraphic) "series" of earth materials. SW & HP

Pliocene - The last epoch of the Tertiary Period of geologic time (from 1.6 to 5.2 million years ago), following the Miocene Epoch and preceding the Pleistocene Epoch; also, the corresponding (time-stratigraphic) "series" of earth materials. HP

plug [volcanic] – A consolidated crater-filling of lava, the surrounding material of which has been largely removed by erosion leaving an isolated hill or knob. Compare – neck [volcanic]. SW & GG

plug dome - A volcanic dome characterized by an upheaved, consolidated conduit filling. GG

pluton - A deep-seated igneous intrusion. GG

plutonic - Pertaining to igneous rocks formed at great depth, but also including associated metamorphic rocks. GG

pluvial lake - A lake formed in a period of exceptionally heavy rainfall; a lake formed in the Pleistocene Epoch during a time of glacial advance, and now either extinct (relict) or existing as a remnant (lake); e.g., Lake Bonneville. Compare - glacial lake, proglacial lake. GG

pocosin - (colloquial: southeastern U.S.A.) A large wet area on broad, commonly a swamp, which occurs on nearly level interfluves in the Atlantic coastal plain with distinctive, native vegetation relative to adjacent areas. Soils may be either mineral or organic. A Native American term for "swamp on a hill." Compare - raised bog. RD

point bar - One of a series of low, arcuate ridges of sand and gravel developed on the inside of a growing meander by the slow addition of individual accretions accompanying migration of the channel toward the outer bank. Compare - meander scroll. GG

point bar [coastal] - Low, arcuate, subaerial ridges of sand developed adjacent to an inlet and formed by the lateral accretion or movement of the channel. Compare – sit. SSS

polje – (not preferred) refer to interior valley.

polygon - A type of patterned ground consisting of a closed, roughly equidimensional figure bounded by more or less straight sides; some sides may be irregular. Refer to patterned ground. Compare - High center polygon, low center polygon, ice wedge polygon, nonsorted polygon. NRC

pond - (a) A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool. (b) A small artificial body of water, used as a source of water. Compare - salt pond. GG

pool - A small, natural body of standing water, usually fresh; e.g. a stagnant body of water in a marsh, or a transient puddle in a depression following a rain. GG

porcellanite - A dense, siliceous rock formed as a indurated or baked clay or shale with a dull, light-colored, cherty appearance, often found in the roof or floor of a burned-out coal seam. GG

postglacial - (not preferred) refer to Holocene.

pothole - [geomorphology] (not preferred) A generic, imprecise term for any pot-shaped pit or hole. GG

pothole -[glacial geology] A type of small pit or closed depression (1 to 15 meters deep), generally circular or elliptical, occurring in an outwash plain, a recessional moraine, or a till plain. GG

pothole -[lake] - A shallow depression, generally less than 10 hectares in area, occurring on disintegration moraines and commonly containing an intermittent or seasonal pond or marsh. GG

pressure ridge [ice] – A rugged, irregular wall of broken floating ice buckled upward by the lateral pressure of wind or current forcing or squeezing one floe against another, or against a shore; it may extend for kilometers in length and up to 30 m in height. Along shores they are lower (< 10 m tall) and contribute to the temporary or permanent formation of a beach berm or a rim of boulders and stones. SW & GG

pressure ridge [volcanic] - An elongate uplift of the congealing crust of a lava flow, probably due to the pressure of the underlying, still-flowing lava; commonly < 5 m in height (but range up to 15 m) and < 100 m length (but can exceed 500 m). Compare – tumulus. SW, GG, & GS

proglacial lake - A type of glacial lake which formed just beyond the margin of an advancing or retreating glacier; generally in direct contact with the ice. Compare - glacial lake, pluvial lake. GG

proglacial lake [relict] - Remnant features of a glacial lake that is now extinct which formed just beyond the margin of an advancing or retreating glacier; generally in direct contact with the ice. Compare - proglacial lake, pluvial lake. SW

proximal [sedimentology] - (adjective) Said of a sedimentary deposit consisting of coarse clastics and deposited nearest the source area. Compare - distal. GG

puff [gilgai] – A surface drape or exposure of up-welled substratum material forced to the surface and outcropping on a low mound or rim; the surface exposure of a chimney [gilgai]; a type of diapir composed of earthy material. Compare – chimney, intermediate position [gilgai], gilgai. SW

pumice - (a) [soils] Rock fragments > 2 mm in diameter (i.e., retained upon a 2 mm sieve), or coherent rock layers (pumice flow), made of light-colored, vesicular, glassy rock commonly having the composition of rhyolite. The material commonly has a specific gravity of < 1.0 and is thereby sufficiently buoyant to float on water. SW; pumice-like fragments < 2 mm in size are called pumiceous ash. ST; Compare - scoria, tephra; (b) [geology] same as (a) but does not include any size restrictions. SW.

pyroclastic – (adj.) Pertaining to clastic rock particles produced by explosive, aerial ejection from a volcanic vent. Such materials may accumulate on land or under water. Compare - epiclastic, volcaniclastic, clastic. G. Smith & HP

pyroclastic flow – A fast density current of pyroclastic material, usually very hot, composed of a mixture of gasses and a variety of pyroclastic particles (ash, pumice, scoria, lava fragments, etc.); produced by the explosive disintegration of viscous lava in a volcanic crater or by the explosive emission of gas-charged ash from a fissure and which tends to follow topographic lows (e.g. valleys) as it moves; used in a more general sense than *ash flow*. Compare –pyroclastic surge, ash flow, nueé ardente, lahar. SW, SN, GG

pyroclastic surge – A low density, dilute, turbulent *pyroclastic flow*, usually very hot, composed of a generally unsorted mixture of gases, ash, pumice and dense rock fragments that travels across the ground at high speed and less constrained by topography than a pyroclastic flow; several types of pyroclastic surges can be specified (e.g. base surge, ash-cloud-surge). Compare - pyroclastic flow. SW, SN, GG

quarry – Excavation areas, open to the sky, usually for the extraction of stone. GG

Quaternary - The period of the Cenozoic Era of geologic time, extending from the end of the Tertiary Period (about 1.6 million years ago) to the present and comprising two epochs, the Pleistocene (Ice Age) and Holocene (Recent); also, the corresponding (time-stratigraphic) "series" of earth materials. GG

radial drainage pattern - A drainage pattern in which consequent streams radiate or diverge outward, like the spokes of a wheel from a high central area.; a major collector stream is usually found in a curvilinear alignment around the bottom of the elevated topographic feature. It is best developed on the slopes of a young domal structure, a volcanic cone, or isolated hills (erosional remnant). SW, GG, WA

railroad bed – The trace or track of a railroad route, commonly raised slightly above the adjacent land, and composed mostly of earthy materials (gravel, rock fragments, etc.). Abandoned or reclaimed beds may no longer be topographically or visually distinct, but the materials used to construct them may still be a significant portion of the soil zone. SW

raised beach - An ancient (relict) beach occurring above the present shoreline and separated from the present beach, having been elevated above the high-water mark either by local crustal movements (uplift) or by lowering of sea or lake level, and which may be bounded by inland cliffs. GG

raised bog - An area of acid, peaty soil, especially that developed from moss, in which the center is higher than the margins. Compare - pocosin, Carolina Bay, moss peat. [Note: raised peat bog (not preferred) - refer to highmoor bog]. SW & GG 87

ravine - A small stream channel; narrow, steep-sided, commonly V-shaped in cross section and larger than a gully, cut in unconsolidated materials. General synonym (not preferred) - gulch. Compare – arroyo, draw, gully. HP

recessional moraine - An end or lateral moraine, built during a temporary but significant halt in the final retreat of a glacier. Also, a moraine built during a minor readvance of the ice front during a period of general recession. Compare - end moraine, ground moraine, terminal moraine. GG

reclaimed land – a) A land area composed of earthy fill material that has been placed and shaped to approximate natural contours, commonly part of land-reclamation efforts after mining operations; b) A land area, commonly submerged in its native state, that has been protected by artificial structures (e.g. dikes) and drained for agricultural or other purposes (e.g. polder). SW

rectangular drainage pattern – A drainage pattern in which the tributaries join the main streams at right-angles, and exhibit sections of approximately the same length which form rectangular shapes; it is indicative of streams following prominent bedrock fault, joint, or foliation systems that break the rocks into rectangular blocks. It is more irregular than the trellis drainage pattern, as the side streams are not perfectly parallel and not necessarily as conspicuously elongated, and secondary tributaries need not be present. The stronger or more harsh the pattern, the thinner the soil cover. These patterns commonly form in slate, schist, and gneiss, in resistive sandstone in arid climates, or in sandstone in humid climates if little soil has developed. SW, GG, WA

reef - (a) A ridge-like or mound-like structure, layered or massive, built by sedentary calcareous organisms, especially corals, and consisting mostly of their remains; it is wave-resistant and stands above the surrounding contemporaneously deposited sediment. Reefs can also include a mass or ridge of rocks, especially coral and sometimes sand, gravel, or shells, rising above the surrounding estuary, sea or lake bottom to or nearly to the surface. SSS, SW & GG

regolith - All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits. Soil scientists regard as soil only that part of the regolith that is modified by organisms and soil-forming processes. Most engineers describe the whole regolith, even to a great depth, as "soil." Compare - residuum, bedrock. HP

relict - (adjective) Pertaining to surface landscape features e.g., landforms, geomorphic surfaces, and paleosols that have never been buried and yet are predominantly products of past environments. Compare - exhumed, buried, ground soil. HP

relict-tidal inlet - A channel remnant of a former tidal inlet. The channel was cutoff or abandoned by infilling from migrating shore sediments. Compare – inlet, tidal inlet. SSS

relief - The relative difference in elevation between the upland summits and the lowlands or valleys of a given region. Compare - local relief. GG

remnant - (not preferred) refer to erosion remnant.

residuum - (residual soil material) Unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place. Compare - colluvium, regolith, saprolite. HP

reworked lake plain – The bottom of a shallow, extinct glacial lake composed of thin (e.g., < 2 m thick), fine-textured, reworked lacustrine sediments that overlie outwash or till; original lacustrine sediments have been subsequently redistributed primarily by wave action (eroded and / or moved a short distance). A distinctive lake plain topography is not always present. It may include subdued, till-capped topographic highs, ringed by shores or strandlines, that were once emergent islands. Common to MI, OH. Compare – till-floored lake plain. SW

rhythmite - An individual unit of a succession of beds developed by rhythmic sedimentation; e.g. a cyclothem. The term implies no limit as to thickness or complexity of bedding and it carries no time or seasonal connotation. Compare - varves, cyclothem. GG

rib – A small, high angle, tertiary spur ridge or mini-interfluve that is a constituent part of rib & groove topography; (slopes generally 20 - 90 %,); common on the mid and lower hillslopes of well dissected uplands. Compare – finger ridge, groove, rib and groove topography. SW

rib and groove topography – A local scale topography composed of repeating, small, high-angle (slopes generally 20 - 90 %), tertiary spur ridges or mini-interfluves (ribs) separated by small, natural, narrow drainageways (grooves); the overall effect is a corrugated transverse surface, common on the mid and lower slopes of well dissected uplands in semi-arid to humid environments (e.g. Basin and Range, Ozarks, etc.). Micro-elevational differences generally range from < 3 to < 15 m. SW

ribbed fen - A nutrient-rich wetland with a surface pattern of ridges and depressions.

rice paddy - An anthropogenic, nearly level impoundment that is inundated for long periods typically for wetland rice production. It is applied to areas that have been used in this fashion for a long enough period of time to significantly change the original soil morphology (especially redoximorphic features). SW

ridge - A long, narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief. HP

rift valley – A valley that has developed along a long, narrow continental trough that has down-dropped and is bounded by normal faults; a graben of regional size. It marks part of a zone along which the entire thickness of the lithosphere has ruptured under crustal extension. SW & GG

rill - A very small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water, usually during and immediately following moderate rains or after ice / snow melt. Generally, a rill is not an obstacle to wheeled vehicles and is shallow enough (e.g., < 0.5 m) to be obliterated by ordinary tillage. Compare - gully. SW & GSST

rim - The border, margin, edge, or face of a landform, such as the curved brim surrounding the top part of a crater or caldera; specifically the rimrock of a plateau or canyon. GG

ripple mark - An undulating surface of alternating, subparallel, small-scale ridges and depressions, commonly composed of loose sand. It is produced on land by wind and under water by the agitation of water by currents or wave action, and generally tends at right angles or obliquely to the direction of flow of the moving fluid. Compare - giant ripple mark. GG

rise - (refer to lake plain) (a) A imprecise term for a slight increase in slope and elevation of the land surface, usually with a broad summit and gently sloping sides. GG (b) [soil survey] same as (a) but the term is restricted to microfeatures in areas of very low relief such as lake plains or coastal plains. SW

rise [geomorphology] - A geomorphic component of flat plains (e.g., lake plain, low coastal plain, low-gradient till plain) consisting of a slightly elevated but low, broad area with low slope gradients (e.g. 1-3 % slopes); typically a microfeature but can be fairly extensive. Commonly soils on a rise are better drained than those on the surrounding talf. Compare - talf. SW

riser [geomorphology] - A geomorphic component of terraces, flood-plain steps, and other stepped landforms consisting of the vertical or steep side slope (e.g. escarpment) typically of minimal aerial extent. Commonly a recurring part of a series of natural, step-like landforms such as successive stream terraces. It's characteristic shape and alluvial sediment composition are derived from the cut and fill processes of a fluvial system. Compare - tread. SW

river [streams] – (a) A general term for a natural, freshwater surface stream of considerable volume and generally with a permanent base flow, moving in a defined channel toward a larger river, lake, or sea. (b) (not recommended: colloquial - New England, USA) A small watercourse which elsewhere in the USA is known as a *creek*. Compare – stream. GG

river valley - an elongate depression of the Earth's surface; carved by a river during the course of it's development. Compare - valley side, valley floor. GG

road bed – The trace or track of a wheeled vehicle route that may or may not be raised slightly above the adjacent land, and composed of earthy fill material (gravel, rock fragments, etc.) or local soil material. Traffic can alter various soil properties primarily by compaction. Abandoned or reclaimed beds may no longer be topographically or visually distinct. However, materials used to construct beds or changes in soil properties may continue to have a significant impact on soil management or plant growth. SW

road cut – A common anthropogenic feature, typically a microfeature, consisting of the sloping, cut surface flanking a road bed on one or both sides, that remains after local topography is minimized by cutting an elongated depression through higher ground during road construction; a type of cutbank. Compare – cut, cutbank. SW

roche moutonnée - A small elongate protruding knob or hillock of bedrock, so sculptured by a large glacier as to have its long axis oriented in the direction of ice movement, an upstream (stoss or scour) side that is gently inclined, smoothly rounded, and striated, and a downstream (lee or pluck) side that is steep and rough. It is usually a few meters in height, length, and breadth. GG

rockfall [mass movement] – The process, associated sediments (rockfall deposit) or resultant landform characterized by a very rapid type of *fall* dominated by downslope movement of detached rock bodies which fall freely through the air or by leaps and bounds (lacks an underlying slip face); also spelled *rock fall.* Compare – debris fall, soil fall, landslide. SW

rockfall avalanche [mass movement] - The process, associated sediments (rockfall avalanche deposit) or resultant landform characterized by an extremely rapid, large type of *rock-fragment flow* (a type of landslide) that starts as a rockfall but turns into a flow and characteristically deposits rock-dominated debris long distances from the failure face (such as 10 – 20 times the fall height); occurs only when huge rockfalls and rockslides involving millions of metric tons of material attain extremely rapid speeds; most common in a rugged mountainous area; ex. the 1903 Franks, Alberta, Canada avalanche. Sometimes loosely referred to as a long run-out landslide. Compare – rock fragment flow, flow, landslide. SW

rock glacier - A mass of poorly sorted angular boulders and fine material, with interstitial ice a meter or so below the surface (ice-cemented) or containing a buried ice glacier (ice-cored). It occurs in a permafrost area, and is derived from a cirque wall or other steep cliff. Rock glaciers have the general appearance and slow movement of small valley glaciers, ranging from a few hundred meters to several kilometers in length, and having a distal area marked by a series of transverse, arcuate ridges. GG

rock pediment – An erosion surface of low relief, cut directly into and across bedrock and composed of either bare rock or thinly veneered pedisediment or residuum (e.g. < 1.5 m) over bedrock; it occurs along the flanks of mountain fronts, or at the base of mountains or high hills. Its surface grades to the backwearing mountain slopes or hillslopes above, and generally grades down to and merges with a lower-lying alluvial plain, piedmont slope or valley floor below. SW & FFP

rock spread [mass movement] – The process, associated sediments (rock spread deposit) or resultant landforms characterized by a very rapid type of *spread* dominated by lateral movement in a rock mass resulting from liquefaction or plastic flow of underlying materials that may be extruded out between intact units; rock bodies predominate. Compare – debris spread, earth spread, landslide. SW & DV

rock topple [mass movement] – The process, associated sediments (rock topple deposit) or resultant landform characterized by a localized, very rapid type of fall in which large blocks of rock material literally fall over, rotating outward over a low pivot point; rock bodies predominate (little fine earth). Portions of the original material may remain intact, although reoriented, within the resulting deposit. Compare – earth topple, debris topple, landslide. SW

rock varnish - A thin, dark, shiny film or coating, composed of iron oxide accompanied by traces of manganese oxide and silica, formed on the surfaces of pebbles, boulders, and other rock fragments, commonly on rock outcrops in arid regions. It is believed to be caused by exudation of mineralized solutions from within and deposition by evaporation on the surface. GG

rotational debris slide – [mass movement] – The process, associated sediments (rotational debris slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely unconsolidated earthy material, portions of which remain largely intact and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass; sediments have substantial proportions of both fine earth and coarse fragments. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare – rotational earth slide, rotational rock slide, translational slide, lateral spread, landslide. SW & DV

rotational earth slide – [mass movement] – The process, associated sediments (rotational earth slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely unconsolidated earthy material, portions of which remain largely intact and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass; sediments predominantly fine earth (< 2 mm). The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare – rotational debris slide, rotational rock slide, translational slide, lateral spread, landslide. SW & DV

rotational landslide – (not preferred) use rotational slide.

rotational rock slide – [mass movement] – The process, associated sediments (rotational rock slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely consolidated rock bodies, portions of which remain largely intact but reoriented, and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare – rotational debris slide, rotational earth slide, translational slide, lateral spread, landslide. SW & DV

rotational slide [mass movement] – The process, associated sediments (rotational landslide deposit) or resultant landforms characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely soil-rock materials, portions of which remain largely intact and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare – rotational debris slide, rotational earth slide, rotational rock slide, translational slide, lateral spread, landslide. SW & DV

rotational slump - (not recommended) use rotational slide.

rubble - An accumulation of loose angular rock fragments, commonly overlying outcropping rock; the unconsolidated equivalent of a breccia. Compare - scree, talus. GG

saddle - A low point on a ridge or interfluve, generally a divide (pass, col) between the heads of streams flowing in opposite directions. Compare - summit, crest. HP

sag – A small, partially or completely closed depression formed by movement along a strike-slip fault, or by mass movement (i.e., landslide) that may or may not temporarily pond water from impounded drainage or surface runoff. For example, a closed depression formed between a scarp or headwall and an adjacent rotated slump block of a landslide. SW

sag pond - A small, permanent body of water in a semi-closed or closed depression formed by movement along a strike-slip fault or by mass movement (i.e., landslide) that ponds water from impounded drainage or surface runoff. Also spelled sagpond. SW & GG

salt marsh - Flat, poorly drained area that is subject to periodic or occasional overflow by salt water, containing water that is brackish to strongly saline, and usually covered with a thick mat of grassy halophytic plants; e.g., a coastal marsh periodically flooded by the sea, or an inland marsh, (or salina) in an arid region and subject to intermittent overflow by salty water. Compare - tidal marsh, mud flat. GG

salt pond - A large or small body of salt water in a marsh or swamp along the seacoast. GG

sand boil - An accumulation of sand commonly in the form of a low mound, produced by the expulsion of liquefied sand to the ground surface; sometimes called sand volcanoes (not preferred). Examples are found on top of some landslide deposits (i.e. spreads) or on the upper surface of highly contorted layers of laminated sediments. SW & GG

sand dune - see dune

sandur – (not preferred – use *outwash plain*).

sand flow [mass movement] – a) A flow of wet sand, as along banks of noncohesive clean sand that is subject to scour and to repeated fluctuations in pore-water pressure due to rise and fall of the tide. b) A flow of loose, dry sand, as along the slip face of a sand dune; typically a microfeature. SW, CV & GG

sandhills - A region of semi-stabilized sand dunes or sandy hills, either covered with vegetation or bare, as in north-central Nebraska and the midlands of the Carolinas. GG

sand pit – A depression, ditch or pit excavated to furnish sand for roads or other construction purposes off-site; a type of borrow pit. SW

sand plain – (a) [geomorphology] A sand-covered plain which may originate by deflation of sand dunes, and who's lower limit of erosion is governed by the ground-water level. Also spelled *sandplain.* GG (b) [glacial geology] (not preferred – refer to *sandy* outwash plain) A small outwash plain composed chiefly of sand deposited by meltwater streams flowing from a glacier. GG

sand ramp – A sand sheet blown up onto the lower slopes of a bedrock hill or mountain and forming an inclined plane, sometimes filling small mountain-side valleys and even crossing low passes. Compare – climbing dune, sand sheet. FFP & SW

sand ridge - (a) (not preferred) An imprecise, generic name for any low ridge of sand, formed at some distance from shore, e.g. submerged (longshore bar) or emergent (barrier beach). (b) One of a series of long, wide, extremely low, parallel ridges believed to represent the eroded stumps of former longitudinal sand dunes, as in western Zimbabwe. GG

sand sheet - A large, irregularly shaped, commonly thin, surficial mantle of eolian sand, lacking the discernible slip faces that are common on dunes. GG

sand volcano – (not preferred) use sand boil.

sand wedge - (not preferred) refer to ice wedge cast.

sandstone - Sedimentary rock containing dominantly sand-size clastic particles. HP

sanitary landfill – A land area where municipal solid waste is buried in a manner engineered to minimize environmental degradation. Commonly the waste is compacted and ultimately covered with soil or other earthy material. Compare – dump. GG

saprolite - Soft, friable, isovolumetrically weathered bedrock that retains the fabric and structure of the parent rock (Colman and Dethier, 1986) and exhibiting extensive inter-crystal and intra-crystal weathering. In pedology, saprolite was formerly applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below. Compare - grus, residuum. SW & HP

scabland - An elevated, flat-lying, basalt-floored area, with little if any soil cover, sparse vegetation, and usually deep, dry channels scoured into the surface, especially by glacial meltwaters such as the Channeled Scablands of eastern Washington. Compare - coulee. GG

scalped area – a) A modified slope, feature, or land area where much or all of the natural soil has been mechanically removed (e.g. scraped off) due to construction or other management practices. Compare – truncated soil. b) A forest soil area where the ground vegetation and root mat has been removed to expose mineral soil in preparation for planting or seeding. Compare – truncated soil. SW

scarp - An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, or structural bench. A scarp may be of any height. Compare - escarpment. GG

scarp slope - The relatively steeper face of a cuesta, facing in a direction opposite to the dip of the strata. Compare - dip slope. GG

scoria - (a) [soils] Vesicular, rock fragments > 2 mm in at least one dimension and a specific gravity > 2.0, or a cindery crust of such material on the surface of andesitic or basaltic lava; the vesicular nature is due to the escape of volcanic gases before solidification; it is usually heavier, darker, and more crystalline than pumice. Compare - cinder, pumice, tephra; (b) [geology] The same as (a) except no size restrictions are applied. SW

scour [geomorphology] - (a) The powerful and concentrated clearing and digging action of flowing air, water, or ice, especially the downward erosion by stream water in sweeping away mud and silt on the outside curve of a bend, or during the time of a flood; a process. (b) A place in a stream bed swept (scoured) by running water, generally leaving a gravel bottom. GG

scour and fill [geomorphology] – A *process* of alternate excavation and refilling of a channel, as by a stream or the tides; especially such a process occurring in time of flood, when the discharge and velocity of an aggrading stream are suddenly increased, causing the digging of new channels that become filled with sediment when the flood subsides. Compare - cut and fill. GG

scree - A collective term for an accumulation of coarse rock debris or a sheet of coarse debris mantling a slope. Scree is not a synonym of talus, as scree includes loose, coarse fragment material on slopes without cliffs. Compare - talus, colluvium, mass movement. HP

scree slope – A portion of a hillside or mountainslope mantled by scree and lacking an up-slope rockfall source (i.e. cliff). Compare – talus slope, scree, talus. SW

scroll - (not preferred) refer to meander scroll.

sea - a) A large inland body of salt water (e.g. the Sultan Sea, CA). b) A geographic subdivision of an ocean (e.g. the South China Sea). Compare – gulf, ocean, salt pond. GG

sea cliff [coastal] - A cliff or slope produced by wave erosion, situated at the seaward edge of the coast or the landward side of the wave-cut platform. It may vary from an inconspicuous slope to a high, steep escarpment. GG

sediment - Material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice or mass-wasting and has come to rest on the earth's surface either above or below sea level. Sediment in a broad sense also includes materials precipitated from solution or emplaced by explosive volcanism, as well as organic remains; e.g., peat that has not been subject to appreciable transport. HP

sedimentary peat [Soil Taxonomy] - An accumulation of organic material that is predominantly the remains of floating aquatic plants (e.g. algae) and the remains and fecal material of aquatic animals, including coprogenous earth. Compare - herbaceous peat, moss peat, woody peat, peat, muck, and mucky peat. SSM

sedimentary rock - A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under "normal" low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, marine deposits; e.g., sandstone, siltstone, mudstone, clay-stone, shale, conglomerate, limestone, dolomite, coal, etc. Compare - sediment. HP

seep - (noun) An area, generally small, where water outflows slowly at the land surface. Flow rates for seeps are too small to be considered as springs, but reflow and / or lateral subsurface flow keeps the surface or near soil saturated during dry periods. SW & GG

seif dune - A large, sharp-crested, elongated, longitudinal (linear) dune or chain of sand dunes, oriented parallel, rather than transverse (perpendicular), to the prevailing wind. If unmodified, the crest, in profile, commonly consists of a succession of curved slip faces produced by strong, but infrequent cross winds. A seif dune may be as much as 200 m high and from 400 m to more than 100 km long. Compare – longitudinal dune. GG and HP

semi-bolson - (colloquial: western USA) A wide desert basin or valley that is drained by an intermittent stream, an externally drained (open) intermontane basin. Compare - bolson GG

semi-open depression – A topographically enclosed basin that generally functions as a closed depression and lacks a defined exit channel. Surface water loss may occur via overland flow through a topographic low area or gap in response to large storm events. Semi-open depressions commonly contain small lakes, ponds, or wet meadows dominated by hydric soils (e.g. in karst valleys, or in low areas on marine terraces with < 1 % slopes). SW

sewage lagoon – Any artificial pond or other water-filled excavation for the natural oxidation of sewage or disposal of animal manure. GG

shale - Sedimentary rock formed by induration of a clay, silty clay, or silty clay loam deposit and having the tendency to split into thin layers, i.e., fissility. HP

sheep tracks - (not recommended) use terracettes.

shield volcano - A volcano having the shape of a very broad, gently sloping dome, built by flows of very fluid basaltic lava or rhyolitic ash flows. Compare - stratovolcano. GG & MA

shoal - (noun) (a) A relatively shallow place in a stream, lake, sea, or other body of water; a shallows. (b) A natural, subaqueous ridge, bank, or bar consisting of, or covered by, sand or other unconsolidated material, rising from the bed of a body of water (e.g. estuarine floor) to near the surface . It may be exposed at low water. Compare - reef. SSS & GG

shoal (relict) - A surficial ridge, bank, or bar consisting of sand or other subaqueous deposit that has become permanently exposed by the retreat or lowering of a proglacial lake or other body of water. Compare - longshore bar [relict]. GG

shore – The narrow strip of land immediately bordering any body of water, esp. the sea or a large lake; specifically the zone over which the ground is alternately exposed and covered by tides or waves, or the zone between high water and low water. GG

shore complex – Generally a narrow, elongate area that parallels a coastline, commonly cutting across diverse inland landforms, and dominated by landforms derived from active coastal processes which give rise to beach ridges, washover fans, beaches, dunes, wave-cut platforms, barrier islands, cliffs, etc. SW

shoreline - The intersection of a specified plane of water with the beach; it migrates with changes of the tide or of the water level. Compare - shore complex, beach, swash zone. GG

shoulder - The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. If present, it comprises the transition zone from summit to backslope. Compare - summit, crest, backslope, footslope, and toeslope. SW & HP

shrub-coppice dune - A small, streamlined dune that forms around brush and clump vegetation. GG

side slope [geomorphology] - A geomorphic component of hills consisting of a laterally planar area of a hillside, resulting in predominantly parallel overland water flow (e.g., sheet wash); contour lines generally form straight lines. Side slopes are dominated by colluvium and slope wash sediments. Slope complexity (downslope shape) can range from simple to complex. Compare - head slope, nose slope, free face, interfluve, crest, base slope. SW; The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve. It is generally linear along the slope width. RR

sidewall – (not preferred) refer to glacial-valley wall.

sill [intrusive rocks] - A tabular, igneous intrusion that parallels the bedding or foliation of the surrounding sedimentary or metamorphic rock. Compare - dike. GG

siltstone - An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay. GG.

sinkhole - A closed, circular or elliptical depression, commonly funnel-shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, salt) (*solution sinkhole*) or by collapse of underlying caves within bedrock (*collapse sinkhole*); diameters range from a few meters to as much as 1000 m. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography. Synonym (not preferred) - doline. Compare – karst valley, interior valley, cockpit. SW & WW

sinkhole karst – A landscape dominated by subsurface drainage and sinkholes (dolines) that range widely in sizes and density; the most common type of karst in **upland areas of** temperate regions (e.g. Highland Rim of TN, northern FL, southwestern MO, etc.); also called doline karst (not preferred). Compare – fluviokarst, pavement karst, glaciokarst, karst. SW, WW, & GG

skid trail – Irregularly spaced, roughly linear to radial depressions or small mounds associated with shallow to deep soil disturbance caused by dragging logs across a slope from where they were cut down to a central processing area such as a log landing during timber harvest operations. SW

slick rock - (colloquial: southwestern U.S.A.) A barren, highly smoothed and subrounded bedrock pavement with considerable, irregular topography sculpted primarily by wind in an arid climate; a type of rock outcrop common on the top of massive sandstone bedrock (e.g. Navajo, Windgate, or Kayenta Formations), especially on summits of ridges and near the leading edge of plateaus, mesas and cuestas. Compare – pavement karst. SW

slackwater - A quiet part of, or a still body of water in a stream. Compare - backswamp. GG

slickensides [pedogenic] - Shrink-swell produced slip faces on pedo-structure faces (e.g. wedges, bowls); grooves, striations, glossy sheen. Most evident in Vertisols. Compare – slickensides [geogenic]. SW

slickensides [geogenic] - Vertical or oblique, roughly planar slip face produced by external forces such as tectonics (e.g. fault), or mass movement (e.g. large slump blocks; grooves, striations on slip face). Compare – slickensides [pedogenic]. SW

slide [mass movement] - (a) - A category of mass movement processes, associated sediments (slide deposit) or resultant landforms (e.g., rotational slide, translational slide, and snowslide) characterized by a failure of earth, snow, or rock under shear stress along one or several surfaces that are either visible or may reasonably be inferred. The moving mass may or may not be greatly deformed, and movement may be rotational (rotational slide) or planar (translational slide). A slide can result from lateral erosion, lateral pressure, weight of overlying material, accumulation of moisture, earthquakes, expansion owing to freeze-thaw of water in cracks, regional tilting, undermining, fire, and human agencies. Compare - fall, topple, lateral spread, flow, complex landslide. SW & DV (b) The track of bare rock or furrowed earth left by a slide. (c) The mass of material moved in or deposited by a slide. Compare - fall, flow, complex landslide, landslide. SW & GG

slip face - The steeply sloping surface on the lee side of a dune, standing at or near the angle of repose of loose sand, and advancing downwind by a succession of slides wherever that angle is exceeded. GG

slip surface – A landslide displacement surface, often slickensided and striated, or brecciated, and subplanar. It is best exhibited in argillaceous materials and in those materials which are highly susceptible to clay alteration when granulated; also called shear surface (not preferred). Compare – main scarp, landslide, escarpment. GG

slope - (also called slope gradient or gradient) The inclination of the land surface from the horizontal. Percent slope is the vertical distance divided by the horizontal distance, then multiplied by 100. SW

slope alluvium - Sediment gradually transported down mountain or hill slopes primarily by non-channel alluvial processes (i.e., slope wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of coarse fragments and may be separated by stone lines. Sorting of rounded or subrounded pebbles or cobbles and burnished peds distinguish these materials from unsorted colluvial deposits. Compare – colluvium, slope wash. SW & HP

slope wash – A collective term for non-fluvial, incipient alluvial *processes* (e.g. overland flow, minor rills) that detach, transport, and deposit sediments down hill and mountain slopes. Related sediments (*slope alluvium*) exhibit nominal sorting or rounding of particles, peds, etc., and lateral sorting downslope on long slopes; stratification is crude and intermittent and readily destroyed by pedoturbation and frost action. Also called *slope wash processes*. Compare – slope alluvium, colluvium, valley-side alluvium. SW

slot canyon – A long, narrow, deep and tortuous channel or drainageway with sheer rock walls eroded into sandstone or other sedimentary rocks, especially in the semi-arid western USA (e.g. Colorado Plateau); subject to flash flood events; depth to width ratios exceed 10:1 over most of its length and can approach 100:1; commonly containing unique ecological communities distinct from the adjacent, drier uplands. SW

slough - (a) A small marsh, especially a marshy area lying in a local, shallow, closed depression on a piece of dry land, as on the prairie of the Midwestern U.S.A. (b) A term used, especially in the Mississippi Valley, for a creek or sluggish body of water in a tidal flat, flood plain, or coastal marshland. Compare - bayou, oxbow. (c) A sluggish channel of water, such as a side channel of a river, in which water flows slowly through low, swampy ground, as along the Columbia River, or a section of an abandoned river channel which may contain stagnant water and occurs in a flood plain or delta. (d) (not preferred) An area of soft, miry, muddy or waterlogged ground, a place of deep mud. GG

sloughed till - (not recommended) use flow till.

slump [mass movement] - (a) (not preferred- refer to rotational slide) A generic, obsolete term for various types of landslides, especially rotational landslide; the process, associated sediments, or resultant landform characterized by a slide involving a shearing and rotary movement of a generally independent mass of rock or earth along a curved slip surface (concave upward) and about an axis parallel to the slope from which it descends, and by backward tilting of the mass with respect to that slope so that the slump surface often exhibits a reversed slope facing uphill. Compare - rotational slide, slide, landslide. SW, GG, & DV. (b) (not recommended) refer to rotational slide. An informal term for the landform or mass of material slipped down during, or produced by a landslide. GG & DV

slump block - A mass of material torn away as a coherent unit during a landslide; a largely intact but displaced and commonly reoriented body of rock or soil. SW & GG

slump till - not recommended; see "flowtill"

snowfield – a) A broad expanse of terrain covered with snow, relatively smooth and uniform in appearance, occurring usually at high latitudes or in mountainous regions above the snowline and persisting throughout year. b) A region of permanent snow cover, as at the head of a glacier; the accumulation area of a glacier. Compare - glacier. GG

soil creep - (not preferred) refer to creep.

soil fall [mass movement] – The process, associated sediments (soil fall deposit) or resultant landform characterized by a rapid type of *fall* involving the relatively free, downslope movement or collapse of detached, unconsolidated soil material which falls freely through the air (lacks an underlying slip face); sediments predominantly fine earth (< 2 mm); common along undercut stream banks. Also called earth fall, and (not recommended) debris fall. Compare – rock fall, debris fall, topple, landslide. SW

soil ripples - (not recommended) use terracettes.

solifluction - Slow, viscous downslope flow of water-saturated regolith. Rates of flow vary widely. The presence of frozen substrate or even freezing and thawing is not implied in the original definition. However, one component of solifluction can be creep of frozen ground. The term is commonly applied to processes operating in both seasonal frost and permafrost areas. Compare - creep. NRC

solifluction deposit – A deposit of non-sorted, water-saturated, earthy material locally derived that is moving or has moved down slope en masse, caused by the melting of seasonal frost or permafrost. SW

solifluction lobe - An isolated tongue-shaped feature up to 25 m wide and 150 m or more long, formed by rapid solifluction on certain sections of a slope showing variations in gradient. This feature commonly has a steep (e.g. 15^{o} - 60^{o}) front and a relatively smooth upper surface. NRC

solifluction sheet - A broad deposit of nonsorted, water-saturated, locally derived material that is moving or has moved downslope, en masse. Stripes are commonly associated with solifluction sheets. Compare – stripe. NRC

solifluction terrace - A low step with a straight or lobate front, the latter reflecting local differences in rate of flow. A solifluction terrace may have bare mineral soil on the upslope part and 'folded under' organic matter in both the seasonally thawed and the frozen soil. NRC

solution chimney – Small diameter (e.g. 1-5 m), irregular, hollow, vertical shaft 5-10+ m deep on karst landscapes, typically covered with a thin layer of soil or plant debris that can collapse and expose the shaft to the surface; represents a significant safety hazard. Locally called "stove-pipe sinkholes in Florida (not recommended). Compare – solution pipe. SW

solution corridor – A straight, open trench about 3 to 10 m wide in a karst area, formed by vertical and lateral solution zones developed along bedrock fractures; also called (not preferred) bogaz, zanjon (Puerto Rico). Compare – cutter, solution fissure, karst valley. SW & GG

solution fissure – One of a series of vertical open cracks commonly < 0.5 m wide dissolved along joints or fractures, separating limestone pavement (pavement karst) into blocks (clints); also called kluftkarren (not preferred). Compare – cutter, solution corridor, karren. SW, GG, & WW

solution pipe – A subsurface, vertical, cylindrical or cone-shaped hole, formed by dissolution in soluble bedrock (e.g. limestone) and often without surface expression, that is filled with detrital material (e.g. soil) and which serves as a bypass route for internal water flow. SW & GG

solution platform – A broad, nearly horizontal intertidal surface (modern or relict) formed across carbonate rocks, produced primarily by solution with contributions by intertidal weathering and biological erosion and deposition, not by abrasion. Compare – wave-cut platform. SW & GG

solution sinkhole – The most common type of sinkhole, caused by dissolution that forms fissures or a chimney and a depression in the bedrock surface which grows when closely spaced fissures underneath it enlarge and coalesce. Compare – collapse sinkhole. SW, WW, & GG

solution valley – (not preferred) use karst valley.

sorted circle - A type of patterned ground whose mesh (shape) is largely circular and has a sorted appearance commonly due to a border of coarse fragments surrounding finer material, occurring either singly or in groups. Diameters range from a few centimeters to more than 10 meters. The coarse fragment border may be 35 cm high and 8 to 12 cm wide. Compare - patterned ground. GG and NRC

sorted polygon - refer to patterned ground.

sound [coast] - a) A relatively long, narrow waterway connecting two larger bodies of water (as a sea or lake with the ocean or another sea) or two parts of the same water body, or an arm of the sea forming a channel between the mainland and an island (e.g. Puget Sound, WA); it is generally wider and more extensive than a strait [coast]. b) A long, large, rather broad inlet of the ocean, generally extending parallel to the coast (e.g. Long Island Sound, NY). C) A lagoon along the southeast coast of the US (e.g. Pamlico Sound, NC). d) A long bay or arm of a lake; a stretch of water between the mainland and a long island in a lake. Compare – sound, lagoon, gulf, ocean. GG

spatter cone - A small, steep-sided cone (e.g., 3 – 15 m high, or more) built up on a lava flow, usually pahoehoe, composed of clots of lava ejected with escaping gases from a vent or fissure which spatters and congeals as it hits the ground to form a small cone; rougher lava clots than a spiracle. Compare – spiracle. SW

specific gravity - The ratio of a material's density to that of water [material weight in air ÷ (weight in air - weight in water)]. Used to differentiate different kinds of volcaniclastics and other materials. SW

spiracle [volcanic] – A small tubular opening or chimney formed by fluid lava congealing and mounding around a fumarolic vent in a basaltic lava flow, usually about 1 m in diameter and up to 5 m high, although in the northwestern USA where spiracles are common they generally are 10 m in diameter and 12 m high or more; formed by a gaseous explosion in lava that is still fluid, probably due to steam generated from underlying wet material; smoother lava clots and drapes than a spatter cone. Compare – spatter cone. SW, GS, & GG

spit - (a) A small point or low tongue or narrow embankment of land, commonly consisting of sand or gravel deposited by longshore transport and having one end attached to the mainland and the other terminating in open water, usually the sea; a finger-like extension of the beach. (b) A relatively long, narrow shoal or reef extending from the shore into a body of water. GG

splay - (not preferred) refer to flood-plain splay.

spoil bank - A bank, mound, or other artificial accumulation of rock debris and earthy dump deposits removed from ditches, strip mines, or other excavations. Compare – dredge spoil bank. SW

spoil pile – (a) A bank, mound, or other artificial accumulation composed of spoil; e.g., an embankment of earthy material removed from a ditch and deposited alongside it. Compare – dredge spoil bank. (b) A pile of refuse material from an excavation or mining operation; e.g., a pile of dirt removed from, and stacked at the surface of a mine in a conical heap or in layers. SW & GG

sporadic permafrost - The area near the southern boundary of discontinuous permafrost where permafrost occurs in isolated patches or islands. Compare - continuous permafrost, discontinuous permafrost. NRC

spread – see lateral spread

spur [geomorphology] - A subordinate ridge or lesser elevation that projects sharply from the crest or side of a hill, mountain, or other prominent range of hills or mountains. GG

spur ridge - (not recommended) use spur.

stack [coast] – An isolated pillar-like rocky island or mass near a cliffy shore, detached from a headland by wave erosion assisted by weathering; especially one showing columnar structure with horizontal stratification. Examples occur along the Oregon coast and the Lake Superior shore. SW & GG

stack [geom] – A steep-sided mass of rock rising above its surroundings on all sides from a slope or hill. Compare – knob. GG

stagnant ice - (a) Glacial ice that is not flowing forward and is not receiving material from an accumulation area; (b) Detached blocks of ice left behind by a retreating glacier, usually buried in a moraine and melting very slowly. GG

star dune – A large, isolated sand dune whose base, in plan view, resembles a star, with sharp-crested ridges converging from basal points to a central peak that may be as high as 100 m above the surrounding plain. It tends to remain fixed for centuries in an area where the wind blows from all directions. Compare – dune. GG

steptoe - An island-like area of older rock surrounded by a lava flow. Compare - kipuka. HP

stock – A relatively small, concordant and / or discordant plutonic rock body exposed at the land surface, with an aerial extent < 40 sq. mi. (100 km^2) and no known bottom. Compare – batholith. GG

stone line - In vertical cross-section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments, commonly a gravel- or cobble-sized lag concentration, that drape across a former topographic surface and later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface. It can best be observed as outcrops in natural and artificial cuts. Also called a carpedolith. Compare - erosional pavement, desert pavement. SW & RR

stone net - (not preferred) refer to patterned ground. Synonym - sorted polygon, stone polygon.

storm surge - An abnormal, sudden rise of sea level along an open coast during a storm, caused primarily by onshore-wind stresses, or less frequently by atmospheric pressure reduction, resulting in water piled up against the coast. It is most severe when accompanied by a high tide. GG

strait [coast] – A relatively narrow waterway connecting two larger bodies of water, as the Straits of Mackinac linking Lake Michigan and Lake Huron; a large channel. Compare – sound. GG

strandline - (a) The shoreline, especially a former (relict) shoreline now elevated above the present water level, that commonly appears as a bench or line wrapping around the landscape at a common elevation. SW (b) A beach, especially one raised above the present sea or lake level. GG

strand plain - A prograded shore built seaward by waves and currents, and continuous for some distance along the coast. It is characterized by subparallel beach ridges and swales, in places with associated dunes. GG

strath terrace - A type of stream terrace, formed as an erosional surface cut on bedrock and thinly mantled (e.g. < 3 m) with stream deposits (alluvium), commonly with a gravel lag deposit immediately above the bedrock. SW & GG

stratified - (adjective) Formed, arranged, or laid down in layers. The term refers to geologic deposits. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata. HP

stratigraphy - The branch of geology that deals with the definition and interpretation of layered earth materials; the conditions of their formation; their character, arrangement, sequence, age, and distribution; and especially their correlation by the use of fossils and other means. The term is applied both to the sum of the characteristics listed and a study of these characteristics. HP

stratovolcano - A volcano that is constructed of alternating layers of lava and pyroclastic deposits, along with abundant dikes and sills. Viscous, acidic lava may flow from fissures radiating from a central vent, from which pyroclastics are ejected. Compare - shield volcano. GG

stream - (a) Any body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the ground surface, in a subterranean cavern, or beneath or in a glacier. It is a mixture of water and dissolved, suspended, or entrained matter. (b) A term used in quantitative geomorphology interchangeably with channel. Compare - river. GG

stream channel - (not preferred) refer to channel.

stream order - An integer system applied to tributaries (stream segments) that documents their relative position within a drainage basin network as determined by the pattern of its confluences. The order of the drainage basin is determined by the highest integer. Several systems exist. In the Strahler system, the smallest unbranched tributaries are designated order 1; the confluence of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3, etc. GG

stream terrace - One, or a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition (i.e., currently very rarely or never floods; inactive cut and fill and/or scour and fill processes). Erosional surfaces cut into bedrock and thinly mantled with stream deposits (alluvium) are called "strath terraces." Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces. Compare - alluvial terrace, flood-plain step, strath terrace, terrace. HP & SW

strike [structural geol.]– The compass direction or trend taken by a structural surface (e.g. a bed or fault plane) as it intersects the horizontal; used in combination with "dip" to describe the orientation of bedrock strata. SW & GG

strike valley – A subsequent valley eroded in, and developed parallel to the strike of, underlying weak strata, such as a cuesta; a valley that commonly, but not necessarily contains a stream valley. SW & GG

string bog - A peatland with roughly parallel, narrow ridges of peat dominated by peat vegetation interspersed with slight depressions, many of which contain shallow pools. The ridges are at right angles to low ($< 2^{o}$) slopes. They are typically 1 to 3 m wide, up to 1 m high and may be over 1 km long. The ridges are slightly elevated and are better drained allowing shrubs and trees to grow. They are best developed in areas of discontinuous permafrost. NRC

stripe - A type of patterned ground; one of the alternating bands of fine and coarse surface material, or of rock or soil and vegetation-covered ground, commonly found on steeper slopes. It is usually straight, but may be sinuous or branching. Compare - patterned ground. GG

stoss – (adj.) Said of the side of the hill or knob that faces the direction from which an advancing glacier or ice-sheet moved; facing the upstream ("up-ice") side of a glacier, and most exposed to its abrasive action. Compare – lee, stoss and lee, crag and tail. GG

stoss and lee – An arrangement of small hills or prominent rocks, in a strongly glaciated area, having gentle slopes on the stoss ("up-ice") side and somewhat steeper, plucked slopes on the lee ("down-ice") side. This arrangement is the opposite of crag and tail. Compare – crag and tail, drumlin, drumlinoid ridge, flute. GG

structural back slope - (not recommended) use dip slope.

structural bench - A platform-like, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude. Structural benches are bedrock controlled, and in contrast to stream terraces, have no geomorphic implication of former, partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching. Compare - pediment, ledge; see scarp. HP

subaerial - (adjective) Said of conditions and processes, such as erosion, that exist or operate in the open air on or immediately adjacent to the land surface; or of features and materials, such as eolian deposits, that are formed or situated on the land surface. Compare – subaqueous. GG

subaqueous – (adjective) Said of conditions and processes, features or deposits, that exist or operate in or under water. Compare – subaerial. SSS & GG

subaqueous landscapes - Permanently submerged areas that are fundamentally the same as subaerial (terrestrial) systems in that they have a discernable topography composed of mappable, subaqueous landforms. SSS

subaqueous soils - Soils that form in sediment found in shallow, permanently flooded environments. Excluded from the definition of these soils are any areas "permanently covered by water too deep (typically greater than 2.5 m) for the growth of rooted plants". SSS

subglacial - (a) Formed or accumulated in or by the bottom parts of a glacier or ice sheet; said of meltwater streams, till, moraine, etc. (b) Pertaining to the area immediately beneath a glacier, as subglacial eruption or subglacial drainage. GG

subglacial melt-out till - (not preferred) refer to till.

subglacial till – Till deposited in or by the bottom parts of a glacier or ice sheet; types include lodgment till, subglacial flow till; synonym (not preferred; obsolete): basal till. SW & GM

submerged-upland tidal marsh – An extensive nearly level, intertidal landform composed of unconsolidated sediments (clays, silts, and/or sand and organic materials), a resistant root mat, vegetated dominantly by hydrophytic (water loving) plants. The mineral sediments largely retain pedogenic horizonation and morphology (e.g. argillic horizons) developed under subaerial conditions prior to submergence due to sea level rise; a type of tidal marsh. Compare – tidal marsh. SW

submerged back-barrier beach - A permanently submerged extension of the back-barrier beach that generally parallels the boundary between estuary and the barrier island. Compare – submerged mainland beach, barrier beach. SSS

submerged mainland beach - A permanently submerged extension of the mainland beach that generally parallels the boundary between an estuary or lagoon and the mainland. Compare – submerged back-barrier beach, barrier beach. SSS

submerged point bar [coastal] - The submerged extension of an exposed (subaerial) point bar. SSS

submerged wave-built terrace - A subaqueous, relict depositional landform originally constructed by river or longshore sediment deposits along the outer edge of a wave-cut platform and later submerged by rising sea level or subsiding land surface. Compare wave – built terrace, wave-cut platform. GG

submerged wave-cut platform - A subaqueous, relict erosional landform that originally formed as a wave-cut bench and abrasion platform from coastal wave erosion and later submerged by rising sea level or subsiding land surface. Compare – wave-built terrace, wave-cut platform. GG

subtidal - (adjective) – Continuous submergence of substrate in an estuarine or marine ecosystem; these areas are below the mean low tide. Compare – intertidal. SSS & CC

subtidal wetlands - Permanently inundated areas within estuaries dominated by subaqueous soils and submerged aquatic vegetation. SSS

summit - (a) The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. Compare - shoulder, backslope, footslope, and toeslope, crest. (b) A general term for the top, or highest area of a landform such as a hill, mountain, or tableland. It usually refers to a high interfluve area of relatively gentle slope that is flanked by steeper slopes, e.g., mountain fronts or tableland escarpments. HP

superglacial - (not recommended) refer to supraglacial.

supraglacial - Carried upon, deposited from, or pertaining to the top surface of a glacier or ice sheet; said of meltwater streams, till, drift, etc. GG

supraglacial debris-flow sediment - (not preferred) refer to "till"

supraglacial melt-out till - (not preferred) refer to "till"

supraglacial till - (not preferred) refer to ablation till.

surface mine - A depression, open to the sky, resulting from the surface extraction of earthy material (e.g. soil / fill) or bedrock material (e.g. coal). Compare – borrow pit, openpit mine, quarry. SW

swale - (a) A shallow, open depression in unconsolidated materials which lacks a defined channel but can funnel overland or subsurface flow into a drainageway. Soils in swales tend to be more moist and thicker (cummulic) compared to surrounding soils. SW (b) A small, shallow, typically closed depression in an undulating ground moraine formed by uneven glacial deposition; Compare - swell-and-swale topography. (c) (not preferred; refer to interdune) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline. GG

swallow hole - A closed depression or doline into which all or part of a stream disappears underground. GG

swamp - An area of low, saturated ground, intermittently or permanently covered with water, and predominantly vegetated by shrubs and trees, with or without the accumulation of peat. Compare - marsh, bog, fen. GG

swash zone - The sloping part of the beach that is alternately covered and uncovered by the uprush of waves, and where longshore movement of water occurs in a zigzag (upslope-downslope) manner. Compare – shoreline. GG

swell - (not recommended) refer to swell-and-swale topography.

swell and swale topography – A local scale topography composed of small, well-rounded hillocks and shallow, closed depressions irregularly spaced across low-relief ground moraine (slopes generally 2 – 6%); the effect is a subdued, irregularly undulating surface that is common on ground moraines. Micro-elevational differences generally range from < 1 to < 5 m. SW

syncline - (a) [landform] A unit of folded strata that is concave upward whose core contains the stratigraphically younger rocks, and occurs at the earth's surface. In a single syncline, beds forming the opposing limbs of the fold dip toward its axial plane. Compare - monocline, syncline, fold. SW & HP (b) [structural geology] A fold, at any depth, generally concave upward whose core contains the stratigraphically younger rocks. GG

tableland - A general term for a broad upland mass with nearly level or undulating summit area of large extent and steep side slopes descending to surrounding lowlands (e.g. a large plateau). Compare - plateau, mesa, cuesta. HP

talf [geomorphology] - A geomorphic component of flat plains (e.g., lake plain, low coastal plain, low-gradient till plain) consisting of an essentially flat (e.g. 0-1 % slopes) and broad area dominated by closed depressions and a non-integrated or poorly integrated drainage system. Precipitation tends to pond locally and lateral transport is slow both above and below ground, which favors the accumulation of soil organic matter and a retention of fine earth sediments; better drained soils are commonly adjacent to drainageways. Compare - rise. SW

talus - Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding. Compare - talus slope, colluvium, mass movement, scree. GG

talus cone – A steep (e.g. 30 - 40°), cone-shaped landform at the base of a cliff or escarpment, that heads in a relatively small declivity or ravine, and composed of poorly sorted rock and soil debris that has accumulated primarily by episodic rockfall or, to a lesser degree, by slope wash. Finest material tends to be concentrated at the apex of the cone. Not to be confused with an *alluvial cone*; a similar feature but of fluvial origin, composed of better stratified and more sorted material, and that tapers up into a more extensive drainageway. Compare – alluvial cone, beveled base, talus slope. SW

talus slope – a portion of a hillslope or mountainslope mantled by talus and lying below a rockfall source (e.g. cliff). Compare – scree slope, scree, talus. Compare – beveled base. SW

tank - (colloquial: southwestern USA) A natural depression or cavity in impervious rocks in which water collects and remains for the greater part of the year. GG

tarn – A relatively deep, steep-banked lake or pool occupying an ice-gouged rock basin amid glaciated mountains. A cirque lake. GG

tephra - A collective, general term for any and all clastic materials, regardless of size or composition, ejected from a vent during a volcanic eruption and transported through the air; including ash [volcanic; < 2 mm], blocks [volcanic; > 64 mm], cinders [volcanic; 2 – 64 mm], lapilli [2 - 76 mm & specific gravity > 2.0], pumice [> 2 mm & specific gravity < 1.0], and scoria [> 2 mm & specific gravity < 2.0]. Tephra, unlike many volcaniclastic terms, does not denote properties of composition, vesicularity, or grain size. SW

terminal moraine - An end moraine that marks the farthest advance of a glacier and usually has the form of a massive arcuate or concentric ridge, or complex of ridges, underlain by till and other drift types. Compare - end moraine, recessional moraine, ground moraine. HP and GG

terrace [geomorphology] - A step-like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (tread), cut or built by stream or wave action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion. Compare - stream terrace, flood-plain step. HP. [soil survey] Practically, terraces are considered to be generally flat alluvial areas above the 100 yr. flood stage. SW

terrace slope - not recommended, use riser

terracettes - Small, irregular step-like forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock such as sheep or cattle. Synonyms (not preferred) - catstep, sheep or cattle track. HP

terrain - A generic name for a tract or region of the Earth's surface considered as a physical feature, an ecological environment, or a site of some planned human activity. GG

Tertiary - The period of the Cenozoic Era of geologic time (approximately from 65 to 1.6 million years ago). Epoch/series subdivisions comprise, in order of increasing age, Pliocene, Miocene, Oligocene, Eocene, and Paleocene. HP

thalweg [geomorphology] - The line of continuous, maximum descent from any point on a land surface; e.g., the line connecting the lowest points along the bed of a stream, or the line crossing all contour lines at right angles. GG

thaw-sensitive permafrost - Perennially frozen ground which, upon thawing, will experience significant thaw settlement and suffer loss of strength to a value significantly lower than that for similar material in an unfrozen condition. Compare - thaw-stable permafrost. NRC

thaw-stable permafrost - Perennially frozen ground which, upon thawing, will not experience either significant thaw settlement or loss of strength. Compare - thaw-sensitive permafrost. NRC

thermokarst - Karst-like topographic features produced in a permafrost region by local melting of ground ice and subsequent settling of the ground. GG

thermokarst depression - A hollow in the ground resulting from subsidence following the local melting of ground ice in a permafrost region. GG

thermokarst drainage pattern – Drainage patterns that form polygonal and hexagonal shapes with streams that may connect rounded depressions, exhibiting a beaded appearance; developed in poorly drained, fine-grained sediments and in organic materials in regions of permafrost. Freezing causes many cracks to develop; thawing causes slumping, settlement, and depressions. This type of drainage pattern with its associated hexagons and beaded ponds indicates the existence or previous presence of permafrost conditions. SW, WA

thermokarst lake - Lake or pond produced in a permafrost region by melting of ground ice. HP

tidal flat - An extensive, nearly horizontal, barren or sparsely vegetated tract of land that is alternately covered and uncovered by the tide, and consists of unconsolidated sediment (mostly clays, silts and/or sands and organic materials). Compare – tidal marsh, wind-tidal flat. GG

tidal inlet - Any inlet through which water alternately floods landward with the rising tide and ebbs seaward with the falling tide. Compare – inlet, relict tidal inlet. GG

tidal marsh – An extensive, nearly level marsh bordering a coast (as in a shallow lagoon, sheltered bay or estuary) and regularly inundated by high tides; formed mostly of unconsolidated sediments (e.g. clays, silts, and/or sands and organic materials), and the resistant root mat of salt tolerant plants; a marshy tidal flat. Compare – tidal flat. SW & GG

till [glacial] - Dominantly unsorted and unstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are imbedded within a finer matrix that can range from clay to sandy loam. Compare - ablation till, basal till, flowtill, lodgment till, drift, moraine. SW & GG

till-floored lake plain – [soil survey] The floor of an extinct glacial lake where a thin (e.g. < 2 m), often discontinuous veneer of lacustrine sediments overlies till. Commonly its topography reflects the underlying, irregular or undulating till surface rather than a distinctive, flat, lake plain surface. It may include subdued, till-capped topographic highs, ringed by shore deposits or strandlines, which were once emergent islands. Compare – reworked lake plain. SW

till plain – An extensive, flat to gently undulating area underlain predominantly by till and bounded on the distal end by subordinate recessional or end moraines. Compare – till, ground moraine. SW

tilted fault block - A fault block that has become tilted, perhaps by rotation on a hinge line (fault). Compare - fault-line scarp. GG

toe [mass movement] – The lowest, usually curved margin of displaced material of a landslide, most distant from the main scarp. Commonly it has an irregular surface that has ripples and may be breached by radial cracks or gaps. Compare – main scarp, minor scarp. CV & SW

toeslope - The hillslope position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear, and are constructional surfaces forming the lower part of a hill-slope continuum that grades to valley or closed-depression floors. Compare - summit, shoulder, backslope, footslope, valley floor. HP

tombolo - A sand or gravel bar or barrier that connects an island with the mainland or with another island. GG

topography - The relative position and elevations of the natural or manmade features of an area that describe the configuration of its surface. HP

topple [mass movement] – A category of processes, associated sediments (topple deposit) or resultant landforms characterized by a localized, very rapid type of fall in which large blocks of soil or rock literally fall over, rotating outward over a low pivot point. Portions of the original material may remain intact, although reoriented, within the resulting debris pile. Types of topples can be specified based on the dominant particle size of sediments (i.e. debris topple, soil topple, rock topple. Compare – fall, flow, slide, spread, complex landslide, landslide. SW & DV

tor - A high, isolated pinnacle, or rocky peak; or a pile of rocks, much-jointed and usually granitic, exposed to intense weathering, and often assuming peculiar or fantastic shapes. GG

Toreva block – A slump block consisting of a single large mass of unjostled material which, during descent, has undergone a backward rotation toward the parent cliff along a horizontal axis that roughly parallels it; a type of rotational landslide. The unit forms a crude, elongated rectangular block rather than a bowl shape or chaotic mass; typically associated with horizontal to gently dipping, interbedded bedrock (e.g. Black Mesa area, NM). SW, GG, & RF

tower karst – (a) A type of tropical karst topography characterized by isolated, steep-sided, residual limestone hills or ridges with vertical or near-vertical walls, and may be relatively flat-topped; commonly surrounded by a flat alluvial plain or lagoons. (Also called *fenglin*). (b) A cluster of peaks or ridges with vertical or near-vertical walls, and convex upper side slopes where towers rise from a common base and are separated by deep, rugged ravines or large sinkholes. (Also called fengcong, turmkarst). Compare – karst tower, cockpit karst, cone karst, fluviokarst, kegel karst, sinkhole karst. SW & GG

translational debris slide [mass movement] – The process, associated sediments (translational debris slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely unconsolidated earthy material, portions or blocks of which remain largely intact and in which movement occurs along a well-defined, planar slip face roughly parallel to the ground surface and resulting in lateral displacement but no rotation of the displaced mass; sediments have substantial proportions of both fine earth and coarse fragments. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare – translational earth slide, translational rock slide, rotational slide lateral spread, landslide. SW & DV

translational earth slide [mass movement] – The process, associated sediments (translational earth slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely unconsolidated earthy material, portions or blocks of which remain largely intact and in which movement occurs along a well-defined, planar slip face roughly parallel to the ground surface and resulting in lateral displacement but no rotation of the displaced mass; sediments predominantly fine earth (< 2 mm). The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare translational debris slide, translational rock slide, rotational slide, lateral spread, landslide. SW & DV

translational rock slide [mass movement] – The process, associated sediments (translational rock slide deposit) or resultant landform characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely consolidated rock bodies, portions or blocks of which remain largely intact and in which movement occurs along a well-defined, planar slip face roughly parallel to the ground surface and resulting in lateral displacement but no rotation of the displaced mass; sediments predominantly fine earth (< 2 mm). The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare translational debris slide, translational earth slide, rotational slide, lateral spread, landslide. SW & DV

translational slide - A category of mass movement processes, associated sediments (translational slide deposit) or resultant landforms characterized by the extremely slow to moderately rapid downslope displacement of comparatively dry soil-rock material on a surface (slip face) that is roughly parallel to the general ground surface, in contrast to falls, topples, and rotational slides. The term includes such diverse *slide* types as translational debris slides, translational earth slide, translational rock slide, block glides, and slab or flake slides.. Compare - rotational slide, slide, landslide. SW, DV, GG

transverse dune - A very asymmetric sand dune elongated perpendicular to the prevailing wind direction, having a gentle windward slope and a steep leeward slope standing at or near the angle of repose of sand; it generally forms in areas of sparse vegetation. Compare – longitudinal dune. GG

tread [geomorphology] - A geomorphic component of terraces, flood-plain steps, and other stepped landforms consisting of the flat to gently sloping, topmost and laterally extensive slope. Commonly a recurring part of a series of natural, step-like landforms such as successive stream terraces. It's characteristic shape and alluvial sediment composition is derived from the cut and fill processes of a fluvial system. Compare - riser. SW

tree-throw – (not preferred) see tree-tip, tree-tip mound, tree-tip pit.

tree-tip – The process of uprooting and tipping over of trees by strong winds, commonly resulting in a small depression from which the root-ball is displaced and an adjacent mound from the sediments subsequently sloughed from the root ball. Most prevalent in shallow forested soils over a restrictive layer (e.g. bedrock); also called tree-throw, windthrow. Compare – tree-tip mound, tree-tip pit. SW

tree-tip mound - The small mound of debris sloughed from the root plate (root ball) of a tipped-over tree. Sometimes called a cradle knoll (not recommended). Local soil horizons are commonly obliterated and result in heterogeneous strata. Compare - tree-tip pit. SW & BHM.

tree-tip pit - The small pit or depression resulting from an area vacated by the root plate (ball) resulting from tree-tip ("tree-throw"). Such pits are commonly adjacent to small mounds composed of the displaced material. Subsequent infilling commonly results in a heterogeneous soil matrix, that may or may not include a stone line that lines the depression. Compare - tree-tip mound. SW & BHM.

tree-tip pit and mound topography – A local-scale topography composed of irregularly spaced, small, closed depressions and adjacent mounds caused by the displacement of root balls from trees knocked down by wind (i.e., tree-tip; also called tree-throw). The result is a subdued, irregularly pock-marked or undulating surface; most common in forested areas overlying shallow rooting conditions (e.g., lithic contact, water table, etc). Micro-elevational differences generally range from 0.5 to < 2 m. Sometimes also referred to as (not preferred:) *cradle and knoll*, or *pit and mound* topography. Compare – tree-tip mound, tree-tip pit. SW

trellis drainage pattern – A drainage pattern characterized by parallel main streams intersected at, or nearly at, right angles by their tributaries, which in turn are fed by elongated secondary tributaries and short gullies parallel to the main streams, resembling, in plan view, the stems of a vine on a trellis. This pattern indicates marked bedrock structural control rather than a type of bedrock and usually indicates in which the main parallel channels follow the strike of the beds. It is commonly developed where the beveled edges of alternating hard and soft rocks outcrop in parallel belts, as in titled, interbedded sedimentary rocks in a rejuvenated folded-mountain region or in a maturely dissected belted coastal plain of tilted strata. SW, GG, WA

tripoli – A light-colored, porous, friable, siliceous (largely chalcedonic) sedimentary rock, which occurs in powdery or earthy masses that result from the weathering of siliceous limestone. It has a harsh, rough feel and is used to polish metals and stones. GG

trough [geomorphology] - (a) Any long, narrow depression in the earth's surface, such as one between hills or with no surface outlet for drainage. (b) (not preferred – see U-shaped valley, mountain valley) A broad, elongate U-shaped valley, such as a glacial trough. Compare - U-shaped valley. GG

trough bottom – (not preferred) refer to glacial-valley floor.

trough end - (not recommended - refer to cirque, cove). The steep, semicircular rock wall forming the abrupt head or end of a U-shaped valley. Compare - headwall. GG

trough valley - (not preferred) refer to U-shaped valley.

trough wall - (not preferred) refer to glacial-valley wall.

truncated soil – Soil that has had part or all of the upper soil horizon(s) removed by erosion, excavation, etc. Compare – scalped area. SW & GSST

tuff - A generic term for any consolidated or cemented deposit that is ≥ 50 percent volcanic ash (< 2 mm); various types of tuff can be recognized based on composition: acidic tuff is predominantly composed of acidic particles; basic tuff is predominantly composed of basic particles. SW

tumulus (pl. tumuli) – A small dome or mound on the surface of a lava flow formed by the buckling of the congealing crust near the edge of a flow caused by differences in flow rates of the cooler crust above and the hotter, more fluid lava below. Dimensions commonly range from < 1 m to 5 m in height, 3 to 10 m in width and 30 to 40 m in length. Some tumuli are hollow. Compare – pressure ridge [volcanic]. SW, GG, and GS

tunnel valley - A relatively shallow trench or depression cut into drift and other loose material, or in bedrock, by a subglacial stream not loaded with coarse sediment that may or may not be part of the present day drainage pattern. GG

tunnel-valley lake – A glacial lake occupying a portion of a tunnel valley. GG

turf hummock - A hummock consisting of vegetation and organic matter with or without a core of mineral soil or stones. Compare - earth hummock, non-sorted circle, patterned ground. NRC

unconformity - A substantial break or gap in the geologic record where a unit is overlain by another that is not in stratigraphic succession. Compare – conformity, discontinuity. GG

underfit stream - A stream that appears to be too small to have eroded the valley in which it flows; a stream whose volume is greatly reduced or whose meanders show a pronounced shrinkage in radius. It is a common result of drainage changes effected by capture, glaciers, or climatic variations. GG

upland [geomorphology] - An informal, general term for (a) the higher ground of a region, in contrast with a low-lying, adjacent land such as a valley or plain. (b) Land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum. Compare - lowland. HP & GG

uplift [tectonic] - A structurally high area in the earth's crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch. GG

upthrust - (a) An upheaval of rock; said preferably of a violent upheaval. (b) A high angle gravity or thrust fault in which the relatively upthrown side was the active (moving) element. HP

U-shaped valley - A valley having a pronounced parabolic cross profile suggesting the form of a broad letter "U", with steep walls and a broad, nearly flat floor; specifically a valley carved by glacial erosion. Compare - V-shaped valley. GG

uvala – (not preferred) refer to karst valley.

valley - An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion or glacial activity. Compare - basin. HP

valley-border surfaces - A general grouping of valley-side geomorphic surfaces of relatively large extent that occur in a stepped sequence graded to successively lower stream base levels, produced by episodic valley entrenchment; for example, multiple stream terrace levels, each with assemblages of constituent landforms (e.g. interfluves, hillslopes, fans, etc.) that dominate the margins of large river valleys. SW & HP

valley fill - The unconsolidated sediment deposited by any agent (water, wind, ice, mass wasting) so as to fill or partly fill a valley. HP

valley flat – A generic term for the low or relatively level ground lying between valley walls and bordering a stream channel; especially the small plain at the bottom of a narrow, steep-sided valley. The term can be generally applied noncommittally to a flat surface that cannot be identified with certainty as a floodplain or terrace. Compare – backswamp, meander belt. GG

valley floor - A general term for the nearly level to gently sloping, lowest surface of a valley. Landforms include axial stream channels, the flood plain, flood-plain steps, and, in some areas, low terrace surfaces. Compare - flood-plain landforms, meander, braided channel, valley side. HP

valley floor remnant - Hills that are highly modified erosional remnants of a former valley or basin floor, composed mostly of unconsolidated valley / basin fill sediments (e.g. alluvium) and typically lie well above the modern valley floor and flood plain. Former basin floor surfaces have become dissected and irregular and consist of hillslope positions (shoulder, backslope, etc.) and hill components (interfluve, headslope, etc.); common in large valleys of the western US. SW

valley side - The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides have been termed valley walls (not recommended). Note: Scale, relief, and perspective may require use of closely related terms such as hill slope or mountain slope. HP

valley-side alluvium - A concave "slope wash" deposit at the base of a hill slope, mountain slope, terrace escarpment, etc., that may or may not include the alluvial toe slope. Compare – base slope, slope alluvium. HP

valley train - A long narrow body of outwash confined within a valley beyond a glacier; it may, or may not, emerge from the valley and join an outwash plain. GG

valley wall - (not recommended) use valley side.

varve - A sedimentary layer, lamina, or sequence of laminae, deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier. Compare - rhythmite. GG

ventifact - A stone or pebble that has been shaped, worn, faceted, cut, or polished by the abrasive action of windblown sand, usually under arid conditions. When the pebble is at the ground surface, as in a desert pavement, the upper part is polished while the lower or below ground part is angular or subangular. GG & HP vernal pool – A natural, seasonal pond in a small closed depression (micro-low) which supports a semi-aquatic or aquatic ecosystem adapted to annual cycles of standing water in the springtime followed by drying in the summer / autumn; commonly recognized in CA. SW

vitric - Pyroclastic material that is more than 75% glass. GG

volcanic - (adjective) Pertaining to (a) the deep seated (igneous) processes by which magma and associated gases rise through the crust and are extruded onto the earth's surface and into the atmosphere, and (b) The structures, rocks, and landforms produced. Compare - extrusive, volcaniclastic. HP

volcanic breccia – A volcaniclastic rock composed mostly of angular rock fragments greater than 2 mm in size. The name volcanic breccia is not synonymous with pyroclastic breccia (volcanic breccia forms in different ways). GG

volcanic cone - A conical hill of lava and/or pyroclastics that is built up around a volcanic vent. GG

volcanic dome - A steep-sided, rounded extrusion of highly viscous lava squeezed out from a volcano, and forming a dome-shaped or bulbous mass of congealed lava above and around the volcanic vent. GG

volcanic field – A more or less well defined area that is covered with volcanic rocks of much more diverse lithology and distribution than a lava field, or that is so modified by age and erosion that it's original topographic configuration, composition and extent is uncertain. Compare – lava field, lava plain. SW

volcaniclastic - Pertaining to the entire spectrum of fragmental materials with a preponderance of clasts of volcanic origin. The term includes not only pyroclastic materials but also epiclastic deposits derived from volcanic source areas by normal processes of mass movement and stream erosion. Examples: welded tuff, volcanic breccia. HP

volcanic plug - (not recommended) use plug.

volcano - (a) A vent in the surface of the Earth through which magma and associated gases and ash erupt; also, the form or structure, usually conical, that is produced by the ejected material. (b) Any eruption of material, e.g. mud, sand, etc. that resembles a magmatic volcano. GG

V-shaped valley - A valley having a pronounced cross profile suggesting the form of the letter "V", characterized by steep sides and short tributaries; specifically a narrow valley resulting from downcutting by a stream. The "V" becomes broader as the downcutting progresses. Compare - U-shaped valley. GG

wash (dry wash) - (colloquial: western U.S.A.) The broad, flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. Note: When channels reach intersect zones of ground-water discharge they are more properly classed as "intermittent stream" channels. Synonym - arroyo. Compare - gully. HP

washover fan - A fan-like deposit of sand washed over a barrier island or spit during a storm and deposited on the landward side. Washover fans can be small to medium sized and completely subaerial, or they can be quite large and include subaqueous margins extending into adjacent lagoons or estuaries. Large fans can be subdivided into sequential parts: ephemeral washover channel (microfeature) cut through dunes or beach ridges, back-barrier flats, (subaqueous) washover-fan flat, (subaqueous) washover-fan slope. Subaerial portions can range from barren to completely vegetated.. SSS

washover-fan apron – (not preferred) use washover-fan flat.

washover-fan flat - A gently sloping, fan-like, subaqueous landform created by overwash from storm surges that transports sediment from the seaward side to the landward side of a barrier island (GG). Sediment is carried through temporary overwash channels that cut through the dune complex on the barrier spit (Fisher and Simpson, 1979; Boothroyd et al., 1985; Davis, 1994) and spill out onto the lagoon-side platform where they coalesce to form a broad belt. Also called storm-surge platform flat (Boothroyd et al., 1985) and washover fan apron (GG). Compare – washover fan slope. SSS

washover-fan slope - A subaqueous extension of a washover-fan flat that slopes toward deeper water of a lagoon or estuary and away from the washover-fan flat. Compare – washover-fan flat. SSS

water [soil survey] - A generic map unit for any permanent, open body of water (pond, lake, reservoir, etc.) that does not support rooted plants. SW

waterway - (a) A general term for a way or channel, either natural (as a river) or artificial (as a canal), for conducting the flow of water. (b) A navigable body or stretch of water available for passage; a watercourse. Compare - drainageway. GG

wave-built terrace - A gently sloping coastal feature at the seaward or lakeward edge of a wave-cut platform, constructed by sediment brought by rivers or drifted along the shore or across the platform and deposited in the deeper water beyond. Compare – submerged wave-built terrace, beach plain, strand plain. **GG**

wave-cut platform - A gently sloping surface produced by wave erosion, extending into the sea or lake from the base of the wave-cut cliff. This feature represents both the wave-cut bench and the abrasion platform. Compare – submerged wave-cut platform. GG

wave-cut terrace - (not recommended) use wave-built terrace.

weathering - All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or circulating surface waters with essentially no transport of the altered material. These changes result in disintegration and decomposition of the material. Compare - regolith, residuum, saprolite. HP

welded soil – (not preferred – use overprinted soil).

welded tuff - A glass-rich, pyroclastic rock composed of volcanic ash indurated at the time of deposition by the welding together of its glass shards under the combined action of the heat retained by particles, the weight of overlying material, and hot gasses. It is generally composed of silica pyroclasts and appears banded or streaked. GG

welding - (a) Consolidation of sediments (especially of clays) by pressure resulting from the weight of superincumbent material or from earth movement, characterized by cohering particles brought within the limits of mutual molecular attraction as water is squeezed out of the sediments. (b) the diagenetic process whereby discrete crystals and/or grains become attached to each other during compaction, often involving pressure solution and pressure transfer. GG

wind gap - A former water gap now abandoned by the stream that formed it, suggesting stream piracy or stream diversion. HP

window [tectonic]- An eroded area of a thrust sheet, commonly a basin or valley floor, that exposes the incongruous bedrock stratigraphy beneath the thrust-sheet; a particular structural or stratigraphic relationship is implied, rather than a particular topographic form. Common in the Appalachian and Rocky Mountain margins. Synonym: *fenster*. GG, WT, SW

windthrow – (not preferred) see tree-tip.

wind-tidal flat – A broad, low-lying, nearly-level sand flat that is alternately inundated by ponded rainwater or by wind-driven bay or estuarine water from storm surges or seiche. Frequent salinity fluctuations and prolonged periods of subaerial exposure preclude establishment of most types of vegetation except for mats of filamentous blue-green algae. Compare – tidal flat. SSS & HF

woody organic materials - see organic materials

woody peat [Soil Taxonomy] - An accumulation of organic material that is predominantly composed of trees, shrubs, and other woody plants. Compare herbaceous peat, moss peat, sedimentary peat, peat, muck, and mucky peat. SSM

yardang - (a) A microfeature in the form of a long, irregular, sharp-crested, undercut ridge between two round-bottomed troughs, carved on a plateau or unsheltered plain in a desert region by wind erosion, and cut into soft but coherent deposits (such as clayey sand); it lies in the direction of the dominant wind, and may be up to 6 m high and 40 m wide. (b) A landform produced in a region of limestone or sandstone by infrequent rains combined with wind action, and characterized by "a surface bristling with a fine lacework of sharp ridges pitted by corrosion". Compare – pavement karst. GG

yardang trough - A long, shallow, round-bottomed groove, furrow, trough, or corridor excavated in the desert floor by wind abrasion, and separating two yardangs. Compare – yardang. GG

zibar – A small, low-relief sand dune that lacks discernible slip faces and commonly occurs on sand sheets, in interdune areas, or in corridors between larger dunes. Zibar spacing can range from 50 – 400 m with local relief < 10 m. Unlike coppice dunes, zibars are not related to deposition around vegetation. Generally dominated by coarser sands. Compare – dune, coppice dune. SW, GG, NL, CW.

629.03 References.

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Exhibit 629-1 Lists of Landscape, Landform, Microfeature, and Anthropogenic Feature Terms defined in the Glossary

(comprehensive alphabetical and subset lists grouped by Geomorphic Process or other groupings). These lists are the core of the *Geomorphic Description System* (Schoeneberger and Wysocki, 2002).

[Note: Various codes follow some of the entries: **NR** - indicates terms that are NOT RECOMMENDED (should not be used); **NP** - indicates terms that are NOT PREFERRED (have been used, but better alternatives are available). Also following terms are italicized letters for the corresponding shorthand code (e.g., *BA*); a dash (--) indicates that as yet, no shorthand code has been assigned.]

I) ALPHABETICAL LISTS (Landscapes, Landforms, Microfeatures, Anthropogenic Features).

A) LANDSCAPES (broad or unique groups or clusters of natural, spatially associated features).

alluvial plain --
alluvial plain remnant --
badlands *BA*
bajada (also Landform) *BJ*
basin *BS*
basin floor (also Landform) --
batholith --
bay [coast] (water body; also Landform) --
bolson *BO*
barrier island (also Landform) --
breaks *BK*
canyonlands --
coastal plain (also Landform) *CP*
cockpit karst --
cone karst --
continental glacier --
delta plain (also Landform) --
drumlin field --
dune field --
estuary (water body; also Landform) --
everglades --
fan piedmont (also Landform) *FP*
fault-block mountains --
fluviokarst --
fluviomarine terrace (also Landform) --
foothills *FH*
glaciokarst --
gulf [coast] (water body; also Landform) --
hills (singular = Landform) *HI*
ice-margin complex --
intermontane basin (also Landform) *IB*
island (also Landform) --
karst *KP*
kegel karst --
lagoon [coast] (water body; also Landform)
lake plain (also Landform) --
lava field (also Landform) --
lava plain (also Landform) --
lava plateau (also Landform) *LL*
lowland --
marine terrace (also Landform) --
meander belt *MB*
mountain range --
mountains (singular = Landform) *MO*
mountain system --
ocean (water body) --
outwash plain (also Landform) --
peninsula --
piedmont *PI*
piedmont slope --
plains (also Landform) *PL*
plateau (also Landform) *PT*
rift valley --
river valley (also Landform) *RV*
sandhills *SH*
sand plain --
scabland *SC*
sea (water body; also Landform) --
semi-bolson *SB*
shore complex --
sinkhole karst --
sound (water body; also Landform) --
strait (water body; also Landform) --
tableland *TB*
thermokarst *TK*
till plain (also Landform) *TP*
tower karst --
upland *UP*

valley (also Landform) *VA*

volcanic field (also Landform) --

B) **LANDFORMS** (discrete, natural, individual, earth-surface features mappable at common survey scales)

`a`a lava flow --
alas *AA*
alluvial cone --
alluvial fan *AF*
alluvial flat *AP*
alpine glacier --
anticline *AN*
arete *AR*
arroyo *AY*
ash flow *AS*
atoll *AT*
avalanche chute *AL*
axial stream --
back-barrier beach --
back-barrier flat --
backshore *AZ*
backswamp *BS*
bajada (also Landscape) *BJ*
ballena *BL*
ballon *BV*
bar *BR*
barchan dune *BQ*
barrier beach *BB*
barrier cove --
barrier flat *BP*
barrier island (also Landscape) *BI*
basin floor (also Landscape) *BC*
basin-floor remnant *BD*
bay [coast] (water body; also Landscape) *WB*
bay [geom.] --
bay bottom --
bayou (water body) *WC*
beach *BE*
beach plain *BP*
beach ridge *BG*
beach terrace *BT*
berm *BM*
beveled base --
blind valley *VB*
block field *BW*
block glide --
block lava flow --
block stream *BX*
blowout *BY*
bluff *BN*
bog *BO*
box canyon --

braided stream *BZ*
broad interstream divide --
butte *BU*
caldera *CD*
canyon *CA*
canyon bench --
Carolina Bay *CB*
channel (also Microfeature) *CC*
chenier *CG*
chenier plain *CH*
cinder cone *CI*
cirque *CQ*
cirque floor --
cirque headwall --
cirque platform --
cliff *CJ*
climbing dune --
closed depression (also Microfeature) --
coastal plain (also Landscape) *CP*
cockpit --
col *CL*
collapsed ice-floored lakebed *CK*
collapsed ice-walled lakebed *CN*
collapsed lake plain *CS*
collapsed outwash plain *CT*
collapse sinkhole --
colluvial apron --
complex landslide --
coral island --
coulee *CE*
cove [coast] (water body) --
cove [geom] *CO*
crag and tail --
crater [volcanic] *CR*
creep --
crevasse filling *CF*
cuesta *CU*
cuesta valley --
cutoff *CV*
debris avalanche *DA*
debris fall --
debris flow *DF*
debris slide --
debris spread --
debris topple --
deflation basin *DB*
deflation flat **--**

delta	*DE*
delta plain (also Landscape)	*DC*
depression	*DP*
diapir	*DD*
diatreme	--
dike	*DK*
dipslope	*DL*
disintegration moraine	*DM*
divide	*DN*
dome	*DO*
drainageway	*DQ*
drainhead complex	-
draw	*DW*
drumlin	*DR*
drumlinoid ridge	--
dune	*DU*
dune field (also Landscape)	--
dune lake (water body)	--
dune slack (also Microfeature)	--
earth flow	*EF*
earth spread	--
earth topple	--
end moraine	*EM*
ephemeral stream (also Microfeature)	--
eroded fan remnant	--
eroded fan-remnant sideslope	--
erosion remnant	*ER*
escarpment	*ES*
esker	*EK*
estuary (water body; also Landscape)	*WD*
faceted spur	*FS*
fall	*FB*
falling dune	--
fan	*FC*
fan apron	*FA*
fan collar	--
fanhead trench	*FF*
fan piedmont (also Landscape)	*FG*
fan remnant	*FH*
fan skirt	*FI*
fault-block	--
fault-line scarp	*FK*
fault zone	--
fen	*FN*
fissure vent	--
fjord (water body)	*FJ*
flat	*FL*
flatwoods	--
flood plain	*FP*
flood-plain playa	*FY*
flood-plain splay	*FM*
flood-plain step	*FO*
flood-tidal delta	--
flood-tidal delta flat	--
flood-tidal delta slope	--
flow	--
flute (also Microfeature)	*FU*
fluviomarine bottom	--
fluviomarine terrace (also Landscape)	--
fold	*FQ*
foredune	*FD*
fosse	*FV*
free face (also Geom. Comp. – Hills, Mountains)	*FW*
fringe-tidal marsh	--
gap	*GA*
geyser	--
geyser basin	--
geyser cone	--
giant ripple	*GC*
glacial drainage channel	*GD*
glacial lake (water body)	*WE*
glacial lake [relict]	*GL*
glacial-valley floor	--
glacial-valley wall	--
glacier	--
gorge	*GO*
graben	*GR*
ground moraine	*GM*
gulch	*GT*
gulf [coast] (water body; also Landscape)	--
gut [stream]; (water body)	*WH*
gut (valley)	*GV*
half graben	--
hanging valley	*HV*
headland	*HE*
head-of-outwash	--
headwall	*HW*
high hill	--
highmoor bog	*HB*
hill	*HI*
hillslope	--
hogback	*HO*
homoclinal ridge	--
horn	*HR*
horst	*HT*
hot spring	--
ice-contact slope	--
ice-marginal steam	--
ice-pushed ridge	--
inlet	--
inselberg	*IN*
inset fan	*IF*
interdrumlin	--
interdune (also Microfeature)	*ID*
interfluve (also Geom. Component - Hills)	*IV*

interior valley --
intermittent stream (also Microfeature) --
intermontane basin (also Landscape) *IB*
island (also Landscape) --
kame *KA*
kame moraine *KM*
kame terrace *KT*
karst cone --
karst tower --
karst valley --
kettle *KE*
kipuka --
knob *KN*
knoll *KL*
lagoon [coast] (water body; also Landscape) *WI*
lagoon bottom --
lagoon channel --
lahar *LA*
lake (water body) *WJ*
lakebed [relict] *LB*
lake plain (also Landscape) *LP*
lakeshore *LF*
lake terrace *LT*
landslide *LK*
lateral moraine *LM*
lateral spread --
lava field (also Landscape) --
lava flow *LC*
lava flow unit (also Microfeature) --
lava plain (also Landscape) *LN*
lava plateau (also Landscape) *LL*
lava trench (also Microfeature) --
lava tube --
ledge *LE*
levee [stream] *LV*
loess bluff *LO*
loess hill *LQ*
longitudinal dune --
longshore bar [relict] *LR*
louderback *LU*
low hill --
lowmoor bog *LX*
maar --
mainland cove --
main scarp (also Microfeature) --
mangrove swamp --
marine lake (water body) --
marine terrace (also Landscape) *MT*
marsh *MA*
mawae --
meander *MB*
meandering channel *MC*
meander scar *MS*
meander scroll *MG*
medial moraine *MH*
mesa *ME*
meteorite crater --
mogote --
monadnock *MD*
monocline *MJ*
moraine *MU*
mountain (plural = Landscape) *MM*
mountain slope *MN*
mountain valley *MV*
mud flat *MF*
mudflow *MW*
mud pot --
muskeg *MX*
natural levee *NL*
neck [volcanic] --
notch *NO*
nunatak *NU*
open depression (also Microfeature) --
outwash delta --
outwash fan *OF*
outwash plain (also Landscape) *OP*
outwash terrace *OT*
overflow stream channel --
oxbow *OX*
oxbow lake (water body) *WK*
oxbow lake (ephemeral) *OL*
paha *PA*
pahoehoe lava flow --
paleoterrace --
parabolic dune *PB*
parna dune *PD*
partial ballena *PF*
patterned ground *PG*
pavement karst --
peak *PK*
peat plateau *PJ*
pediment *PE*
perennial stream (water body) --
pillow lava flow --
pingo *PI*
pinnacle --
pitted outwash plain *PM*
pitted outwash terrace --
plain (also Landscape) *PN*
plateau (also Landscape) *PT*
playa *PL*
playa dune (also Microfeature) --
playa floor (also Microfeature) --
playa lake (water body) *WL*
playa rim (also Microfeature) --

playa slope (also Microfeature) --
playa step (also Microfeature) --
plug [volcanic] --
plug dome *PP*
pluvial lake (water body) *WM*
pluvial lake (relict) *PQ*
pocosin *PO*
point bar *PR*
point bar [coastal] --
pothole (also Microfeature) *PH*
pothole lake (water body) *WN*
pressure ridge [ice] --
pressure ridge [volcanic]; also Micro.) *PU*
proglacial lake (water body) *WO*
proglacial lake [relict] --
pyroclastic flow --
pyroclastic surge --
raised beach *RA*
raised bog *RB*
ravine *RV*
recessional moraine *RM*
reef *RF*
relict-tidal inlet (water body) --
reworked lake plain --
ribbed fen *RG*
ridge *RI*
rim *RJ*
river (water body) --
river valley (also Landscape) --
roche moutonnée (also Microfeature) *RN*
rock fall (also Microfeature) --
rock avalanche --
rock glacier *RO*
rock pediment --
rock spread --
rock topple --
rotational debris slide --
rotational earth slide --
rotational rock slide --
rotational slide *RP*
saddle *SA*
sag (also Microfeature)--
sag pond (water body, also Microfeature) --
salt marsh *SM*
salt pond (water body also Microfeature) *WQ*
sand flow *RW*
sand ramp --
sand sheet *RX*
scarp *RY*
scarp slope *RS*
scree slope --
sea (water body; also Landscape) --
sea cliff *RZ*

seif dune *SD*
semi-open depression --
shield volcano --
shoal (water body) *WR*
shoal (relict) *SE*
shore --
sill *RT*
sinkhole *SH*
slackwater (water body) *WS*
slick rock (also Microfeature) --
slide *SJ*
slot canyon --
slough (ephemeral water) *SL*
slough (permanent water) *WU*
slump *SK*
slump block *SN*
snowfield --
soil fall --
solution platform --
solution sinkhole --
sound (water body; also Landscape) --
spit *SP*
spur *SQ*
stack [coast] --
stack [geom] *SR*
star dune --
steptoe *ST*
stock --
stoss and lee --
strait (water body; also Landscape) --
strand plain *SS*
strath terrace *SU*
stratovolcano *SV*
stream (water body) --
stream terrace *SX*
strike valley --
string bog *SY*
structural bench *SB*
submerged back-barrier beach --
submerged mainland beach --
submerged point bar [coastal] --
submerged-upland tidal marsh --
submerged wave-built terrace --
submerged wave-cut platform --
swale (also Microfeature) *SC*
swallow hole *TB*
swamp *SW*
syncline *SZ*
talus cone --
talus slope --
tarn (water body; also Microfeature) --
terminal moraine *TA*
terrace *TE*
thermokarst depression *TK*

thermokarst lake (water body)	*WV*	valley flat	*VF*
tidal flat	*TF*	valley floor	*VL*
tidal inlet	--	valley floor remnant	--
tidal marsh	--	valley side	*VS*
till-floored lake plain	--	valley train	*VT*
till plain (also Landscape)	*TP*	volcanic cone	*VC*
toe (also Microfeature)	--	volcanic dome	*VD*
tombolo	*TO*	volcanic field (also Landscape)	--
topple	--	volcano	*VO*
tor	*TQ*	V-shaped valley	*VV*
Toreva block	--	wash	*WA*
translational debris slide	--	washover fan	*WF*
translational earth slide	--	washover-fan flat	--
translational rock slide	--	washover-fan slope	--
translational slide	*TS*	wave-built terrace	*WT*
transverse dune	*TD*	wave-cut platform	*WP*
trough	*TR*	wind gap	*WG*
tunnel valley	*TV*	window	--
tunnel-valley lake (water body)	--	wind-tidal flat	--
U-shaped valley	*UV*	yardang (also Microfeature)	--
valley	*VA*	yardang trough (also Microfeature)	--
valley-border surfaces	--		

C) MICROFEATURES (discrete, natural, earth-surface features typically too small to delineate at common survey scales).

bar	--	gully	--
channel (also Landform)	--	hillock	--
closed depression (also Landform)	--	hoodoo	--
corda	--	interdune (also Landform)	--
cutter	--	intermittent stream (water body; also Landform)	
dune slack (also Landform)	--	karren	--
dune traces	--	lava flow unit (also Landform)	–
earth pillar	--	lava trench (also Landform)	--
ephemeral stream (also Landform)	--	main scarp (also Landform)	--
finger ridge	--	minor scarp	--
flute (also Landform)	--	mound	*M*
frost boil	--	nivation hollow	--
glacial groove	--	open depression (also Landform)	--
groove	--	patterned ground *(see below)*	*PG*

Patterned ground microfeatures (used in association with the landform "patterned ground" or *PG*):

a) *Periglacial* patterned ground microfeatures:

circle	--	palsa, palsen	--
earth hummocks	--	(= peat hummocks)	--
high-center polygons	--	polygons	--
ice wedge polygons	--	sorted circles	--
low-center polygons	--	stripes	--
non-sorted circles	--	turf hummocks	--

b) ***Other*** patterned ground microfeatures:

bar and channel	--
circular gilgai	--
elliptical gilgai	--
linear gilgai	--
gilgai	*G*
hummocks	--
intermediate position [gilgai]	--
mima mounds	--
pimple mounds	--

perennial stream (water body; also Landform) --
pinnacle --
playa dune (also Landform) --
playa floor (also Landform) --
playa rim (also Landform) --
playa slope (also Landform) --
playa step (also Landform) --
playette --
pond (water body) --
pool (water body) --
pothole (also Landform) --
pressure ridge [volcanic] --
rib --
rill --
ripple mark --
roche moutonnée (also Landform) --
rockfall (also Landform) --
sag (also Landform) --
sag pond (water body; also Landform) --
sand boil --
scour (mark) --
shoreline --
shrub-coppice dune --
slick rock (also Landform) --
slip face --
solifluction lobe --
solifluction sheet --
solifluction terrace --
solution chimney --
solution corridor --
solution fissure --
solution pipe --
spatter cone --
spiracle --
strandline --
swale (also Landform) --
swash zone --
tank (water body) --
tarn (water body; also Landform) --
terracettes *T*
toe [mass move.] (also Landform) --
tree-tip mound --
tree-tip pit --
tumulus (tumuli = plural) --
vernal pool (seasonal water body) --
yardang (also Landform) --
yardang trough (also Landform) --
zibar --

D) ANTHROPOGENIC FEATURES [discrete, artificial (human-made or extensively modified), earth-surface features].

artificial collapsed depression	*G*	log landing	--
artificial levee	*A*	midden	*H*
beveled cut	--	openpit mine	--
borrow pit	--	pond *(human-made)*	--
burial mound	*B*	quarry	--
cut *(road, railroad)*	--	railroad bed	*D*
cutbank	--	reclaimed land	--
ditch	--	rice paddy	*E*
dredged channel	--	road bed	*I*
dredge-deposit shoal	--	road cut	--
dredge spoil bank	--	sand pit	--
dump	--	sanitary landfill	--
fill	--	scalped area	
filled marshland	--	sewage lagoon	--
floodway	--	skid trail	--
gravel pit	--	spoil bank	--
impact crater	--	spoil pile	--
landfill *(see sanitary landfill)*		surface mine	--
leveled land	--	tillage features *(below)*	F

Tillage / Management features (common types) :

conservation terrace *(modern)*	--	hillslope terrace *(e.g., archeological features)*	--
double-bedding mound	--		
drainage ditch	--	inter-furrow	--
furrow	--		

truncated soil	--
urban land	--

II) GEOMORPHIC ENVIRONMENTS AND OTHER GROUPINGS (Landscape, Landform, and Microfeature terms grouped by geomorphic process (e.g. Fluvial) or common settings (e.g. Water Bodies). These lists are not mutually exclusive and some features occur in more than one environment or setting.)

1. COASTAL MARINE and ESTUARINE (wave or tidal control or near-shore / shallow marine).

Landscapes:

bay [coast] (water body; also Landform) --
coastal plain (also Landform) *CP*
barrier island (also Landform) --
estuary (water body; also Landform) –
fluviomarine terrace (also Landform) --
gulf [coast] (water body; also Landform) --
island (also Landform) --
lagoon [coast] (water body; also Landform) --
lowland --
marine terrace (also Landform) --
ocean (water body; also Landform) --
peninsula --
sea (water body; also Landform) --
shore complex --
sound (water body; also Landform) --
strait (water body; also Landform) --

Landforms:

atoll *AT*
back-barrier beach --
back-barrier flat --
backshore *AZ*
bar *BR*
barrier beach *BB*
barrier cove --
barrier flat *BF*
barrier island (also Landscape) *BI*
bay [coast] (water body; also Landscape) *WB*
bay bottom --
beach *BE*
beach plain *BP*
beach ridge *BG*
beach terrace *BT*
berm *BM*
bluff *BN*
chenier *CG*
chenier plain *CH*
coastal plain *CP*
coral island --
delta *DE*
delta plain (also Landscape) *DC*
drainhead complex -
flat *FL*
flatwoods --
fluviomarine terrace (also Landscape) --
foredune *FD*
fringe-tidal marsh --
gulf [coast] (water body; also Landscape) --
headland *HE*
island (also Landscape) --
lagoon [relict] *WI*
lagoon (water body) --
longshore bar [relict] *LR*
mangrove swamp --
marine lake (water body)--
marine terrace (also Landscape) *MT*
mud flat *MF*
point bar [coastal] --
raised beach *RA*
reef *RF*
salt marsh *SM*
sea (water body; also Landscape) --
sea cliff *RZ*
semi-open depression --
shoal (relict) *SE*
shore --
sound (water body; also Landscape) --
spit *SP*
stack [coast] --
strait (water body; also Landscape) --
strand plain *SS*
tidal flat *TF*
tidal marsh --
tombolo *TO*
washover fan *WF*
wave-built terrace *WT*
wave-cut platform *WP*
wind-tidal flat --

Microfeatures:

ripple mark	--	swash zone	--
shoreline	--		

2. LACUSTRINE (related to inland water bodies).

Landscapes:

island (also Landform)	--	shore complex	--
lake plain (also Landform)	--		
peninsula	--		

Landforms:

backshore	*AZ*	lake terrace	*LT*
bar	*BR*	longshore bar [relict]	*LR*
barrier beach	*BB*	mud flat	*MF*
barrier flat	*BF*	oxbow lake (ephemeral)	*OL*
barrier island	*BI*	playa	*PL*
beach	*BE*	playa floor (also Microfeature)	--
beach plain	*BP*	playa rim (also Microfeature)	--
beach ridge	*BG*	playa slope (also Microfeature)	--
beach terrace	*BT*	playa step (also Microfeature)	--
berm	*BM*	pluvial lake (relict)	*PQ*
bluff	*BN*	raised beach	*RA*
delta	*DE*	reworked lake plain	--
delta plain (also Landscape)	*DC*	salt marsh	*SM*
flat	*FL*	shoal (relict)	*SE*
flood-plain playa	*FY*	shore	--
foredune	*FD*	spit	*SP*
headland	*HE*	stack [coast]	--
island (also Landscape)	--	strand plain	*SS*
lagoon [relict]	*WI*	till-floored lake plain	--
lakebed [relict]	*LB*	tombolo	*TO*
lakebed (water body)	*LB*	wave-built terrace	*WT*
lake plain (also Landscape)	*LP*	wave-cut platform	*WP*

Microfeatures:

bar	--		
playa floor (also Landform)	--	ripple mark	--
playa rim (also Landform)	--	shoreline	--
playa slope (also Landform)	--	strandline	--
playa step (also Landform)	--	swash zone	--
playette	--	vernal pool	--

3. **FLUVIAL** (dominantly related to concentrated water flow (channel flow); includes erosional and depositional features, but excluding glaciofluvial landforms (see Glacial), and permanent water features (see Water Bodies).

Landscapes:

alluvial plain	--
alluvial plain remnant	--
badlands	*BA*
bajada	*BJ*
breaks	*BK*
canyonlands	--
delta plain	--
fan piedmont	*FP*
meander belt	*MB*
river valley	--
scabland	*SC*

Landforms:

alluvial cone	--
alluvial fan	*AF*
alluvial flat	*AP*
arroyo	*AY*
axial stream (water body)	--
backswamp	*BS*
bajada	*BJ*
bar	*BR*
basin-floor remnant	*BD*
block stream	*BX*
braided stream	*BZ*
box canyon	--
canyon	*CA*
channel	*CC*
coulee	*CE*
cutoff	*CV*
delta	*DE*
delta plain (also Landscape)	*DC*
drainageway	*DQ*
drainhead complex	-
draw	*DW*
ephemeral stream (also Microfeature)	--
fan apron	--
fan collar	--
fanhead trench	*FF*
fan remnant	--
fan skirt	*FI*
flood plain	*FP*
flood-plain playa	*FY*
flood-plain splay	*FM*
flood-plain step	*FO*
giant ripple	*GC*
gorge	*GO*
gulch	*GT*
gut (valley)	*GV*
inset fan	*IF*
intermittent stream (also Microfeature)	--
levee [streams]	*LV*
meander scar	*MS*
meander scroll	*MG*
natural levee	*NL*
overflow stream channel	--
oxbow	*OX*
oxbow lake (ephemeral)	*OL*
paleoterrace	--
point bar	*PR*
ravine	*RV*
river valley (also Landscape)	--
semi-open depression	--
slot canyon	--
strath terrace	*SU*
stream terrace	*SX*
valley border surfaces	--
valley flat	--
valley floor remnant	--
wash	*WA*
wind gap	*WG*

Microfeatures:

bar	--
bar & channel	--
channel	--
ephemeral stream (also Landform)	--
groove	--
gully	--
intermittent stream (also Landform)	--
ripple mark	--
swash zone	--

4. **SOLUTION** (dominated by dissolution, and commonly, subsurface drainage).

Landscapes:

cockpit karst	--
cone karst	--
fluviokarst	--
glaciokarst	--
karst	*KP*
kegel karst	--
sinkhole karst	--
thermokarst	*TK*
tower karst	--

Landforms:

blind valley	*VB*
cockpit	--
collapse sinkhole	--
interior valley	--
karst cone	--
karst tower	--
karst valley	--
mogote	--
pavement karst	--
pinnacle	--
sinkhole	*SH*
solution platform	--
solution sinkhole	--
swallow hole	*TB*
thermokarst depression (also Microfeature)	*TK*
yardang (also Microfeature)	--
yardang trough (also Microfeature)	*TK*

Microfeatures:

cutter	--
karren	--
solution chimney	--
solution corridor	--
solution fissure	--
solution pipe	--
thermokarst depression (also Landform)	--
yardang (also Landform)	--
yardang trough (also Landform)	--

5. **EOLIAN** (dominantly wind related, erosional or depositional).

Landscapes:

dune field	--
sandhills	*SH*
sand plain	--

Landforms:

barchan dune	*BQ*
blowout	*BY*
climbing dune	--
deflation basin	*DB*
dune	*DU*
dune field (also Landscape)	--
dune lake (water body)	--
dune slack (also Microfeature)	--
falling dune	--
foredune	*FD*
interdune	*ID*
loess bluff	*LO*
loess hill	*LQ*
longitudinal dune	--
paha	*PA*
parabolic dune	*PB*
parna dune	*PD*

playa dune (also Microfeature)	--	star dune	--
sand ramp	--	transverse dune	*TD*
sand sheet	*RX*	yardang (also Microfeature)	--
seif dune	*SD*	yardang trough (also Microfeature)	--
slick rock (also Microfeature)	--		

Microfeatures:

dune slack (also Landform)	--	slip face	--
dune traces	--	yardang (also Landform)	--
interdune (also Landform)	--	yardang trough (also Landform)	--
playa dune (also Landform)	--	zibar	--
playette	--		
shrub-coppice dune	--		
slick rock (also Landform)	--		

6. **GLACIAL** (directly related to glaciers; includes glaciofluvial, glaciolacustrine, glaciomarine, and outwash features).

Landscapes:

continental glacier	--	ice-margin complex	--
drumlin field	--	outwash plain (also Landform)	--
glaciokarst	--	till plain (also Landform)	*TP*
hills	*HI*		

Landforms:

alpine glacier	--	glacial lake (water body)	--
arete	*AR*	glacial-valley floor	--
cirque	*CQ*	glacial-valley wall	--
cirque floor	--	glacier	--
cirque headwall	--	ground moraine	*GM*
cirque platform	--	hanging valley	*HV*
col	*CL*	head-of-outwash	--
collapsed ice-floored lakebed	*CK*	ice-contact slope	--
collapsed ice-walled lakebed	*CN*	ice-marginal stream	--
collapsed lake plain	*CS*	ice-pushed ridge	--
collapsed outwash plain	*CT*	interdrumlin	--
crag and tail	--	kame	*KA*
crevasse filling	*CF*	kame moraine	*KM*
disintegration moraine	*DM*	kame terrace	*KT*
drumlin	*DR*	kettle	*KE*
drumlinoid ridge	--	lateral moraine	*LM*
end moraine	*EM*	medial moraine	*MH*
esker	*EK*	moraine	*MU*
fjord (water body)	*FJ*	nunatak	*NU*
flute (also Microfeature)	*FU*	outwash delta	--
fosse	*FV*	outwash fan	*OF*
giant ripple	*GC*	outwash plain (also Landscape)	*OP*
glacial drainage channel	*GD*	outwash terrace	*OT*
glacial lake [relict]	*GL*	paha	*PA*

pitted outwash plain *PM*
pitted outwash terrace --
pothole (also Microfeature) *PH*
pressure ridge [ice] --
proglacial lake [relict] --
proglacial lake (water body) --
recessional moraine *RM*
reworked lake plain --
roche moutonnée (also Microfeature) *RN*
rock glacier *RO*
snowfield --
stoss and lee --
tarn (water body; also Microfeature) --
terminal moraine *TA*
till-floored lake plain --
till plain (also Landscape) *TP*
tunnel valley *TV*
tunnel-valley lake (water body) --
underfit stream --
valley train *VT*
U - shaped valley *UV*

Microfeatures:

flute (also Landform) --
glacial groove --
ice wedge --
ice wedge cast --
nivation hollow --
pothole [glacial] --
roche moutonnée (also Landform) --
swale (also Landform)--
tarn (water body; also "Landform") --

7. **PERIGLACIAL** [related to non-glacial, cold climate (modern or relict), including periglacial forms of patterned ground. Note: consider "patterned ground" as a Landform, but treat specific types of patterned ground, singular or plural, as Microfeatures.]

Landscapes:

coastal plain (*e.g. North Slope, AK*) *CP*
hills *HI*
plains *PL*
thermokarst *TK*

Landforms:

alas *AA*
block field *BW*
muskeg *MX*
patterned ground (see *Microfeatures* for types) *PG*
peat plateau *PJ*
pingo *PI*
rock glacier *RO*
string bog *SY*
thermokarst depression *TK*
thermokarst lake (water body) --

Microfeatures:

circle --
earth hummocks --
frost boil --
high-center polygons --
ice wedge polygons --
low-center polygons --
nivation hollow --
non-sorted circles --
palsa (palsen = *plural*; = peat hummocks) --
polygon --
solifluction lobe --
solifluction sheet --
solifluction terrace --
sorted circles --
stripes --
turf hummocks --

8. MASS MOVEMENT (MASS WASTING) (dominated by gravity, including creep forms).

Landscapes: (these generic Landscapes are not Mass Movement features per say, but are commonly modified by, and include localized areas of, Mass Movement).

foothills	*FH*
hills	*HI*
mountain range	--
mountains	*MO*

Landforms:

ash flow	*AS*
avalanche chute	*AL*
block glide	--
block stream	*BX*
colluvial apron	--
complex landslide	--
creep	--
debris avalanche	--
debris fall	--
debris flow	*DF*
debris slide	--
debris spread	--
debris topple	--
earth flow	*EF*
earth spread	--
earth topple	--
fall	*FB*
flow	--
lahar	*LA*
landslide	*LK*
lateral spread	--
main scarp (also Microfeature)	--
mudflow	*MW*
rock fall (also Microfeature)	--
rockfall avalanche	--
rock spread	--
rock topple	--
rotational debris slide	--
rotational earth slide	--
rotational rock slide	--
rotational slide	*RP*
sag (also Microfeature)	--
sag pond (water body; also Micro.)	--
sand flow	*RW*
scree slope	--
slide	*SJ*
slump	*SK*
slump block	*SN*
soil fall	--
talus cone	--
talus slope	--
toe [mass move.] (also Micro.)	--
topple	--
Toreva block	--
translational debris slide	--
translational earth slide	--
translational rock slide	--
translational slide	*TS*

Microfeatures:

main scarp (also Landform)	--
minor scarp	--
rockfall (also Landform)	--
sag (also Landform)	--
sag pond (also Landform)	--
sand boil	--
solifluction lobe	--
solifluction sheet	--
solifluction terrace	--
terracettes	*T*
toe [mass move.] (also Landform)	--

9. VOLCANIC and HYDROTHERMAL

Landscapes:

foothills	*FH*
hills	*HI*
lava field (also Landform)	--
lava plain (also Landform)	--
lava plateau (also Landform)	--
mountains	*MO*
volcanic field (also Landform)	--

Landforms:

`a`a lava flow	--
ash flow	*AS*
block lava flow	--
caldera	*CD*
cinder cone	*CI*
crater [volcanic]	*CR*
diatreme	--
fissure vent	--
geyser	--
geyser basin	--
geyser cone	--
hot spring	--
kipuka	--
lahar	*LA*
lava field (also Landscape)	--
lava flow-unit (also Microfeature)	--
lava flow	*LC*
lava plain (also Landscape)	*LN*
lava plateau (also Landscape)	*LL*
lava trench (also Microfeature)	--
lava tube	--
louderback	*LU*
maar	--
mawae	--
mud pot	--
neck [volcanic]	--
pahoehoe lava flow	--
pillow lava flow	--
plug [volcanic]	--
plug dome	*PP*
pressure ridge [volcanic] (also Micro.)	*PU*
pyroclastic flow	--
pyroclastic surge	--
shield volcano	--
steptoe	*ST*
stratovolcano	*SV*
volcanic cone	*VC*
volcanic dome	*VD*
volcanic field (also Landscape)	--

Microfeatures:

corda	--
lava flow unit (also Landform)	--
lava trench (also Landform)	--
pressure ridge [volc.] (also Landform)	--
spatter cone	--
spiracle	--
tumulus (tumuli = plural)	--

10. TECTONIC and STRUCTURAL (related to regional or local bedrock structures, or crustal movement. In Soil Survey, tectonic and structural features are only recognized if they have some expression at or near the land surface).

Landscapes:

batholith	--
bolson	*BO*
fault-block mountains	--
foothills	*FH*
hills	*HI*
intermontane basin	*IB*
mountain range	--
mountains	*MO*
mountain system	--
plateau	*PT*
rift valley	--
semi-bolson	*SB*
tableland	*TB*
valley	*VA*

Landforms:

anticline	*AN*
canyon bench	--
cuesta	*CU*
cuesta valley	--
diapir	*DD*
dike	*DK*
dipslope	*DL*
dome	*DO*
fault-line scarp	*FK*
fault-block	--
fault zone	--
fold	*FQ*
graben	*GR*
half graben	--
hogback	*HO*
homoclinal ridge	--
horst	*HT*
louderback	*LU*
meteorite crater	--
monocline	*MJ*
scarp slope	*RS*
sill	*RT*
stock	--
strike valley	--
structural bench	*SB*
syncline	*SZ*
window	--

Microfeatures:

sand boil	--

11. **SLOPE** - generic terms or those that describe slope form, geometry, or arrangement of land features, rather than any particular genesis or process.

Landscapes:

badlands	*BA*
breaks	*BK*
canyonlands	--
foothills	*FH*
hills	*HI*
mountain range	--
mountains	*MO*
mountain system	--
piedmont	*PI*
piedmont slope	--
plateau (also Landscape)	*PT*
tableland	*TB*
upland	*UP*

Landforms:

beveled base	--
block stream	*BX*
bluff	*BN*
broad interstream divide	--
butte	*BU*
canyon bench	--
cliff	*CJ*
colluvial apron	--
cuesta	*CU*
dome	*DO*
escarpment	*ES*
faceted spur	*FS*
fault-line scarp	*FK*
free face (also Geom Component – Hills, Mountains.)	*FW*
gap	*GA*
headwall	*HW*
high hill	--
hill (plural = Landscape)	*HI*
hillslope	--
hogback	*HO*
interfluve (also Geom. Component - Hills)	*IV*
knob	*KN*
knoll	*KL*
ledge	*LE*
low hill	--
mesa	*ME*
mountain (plural = Landscape)	*MM*
mountain slope	*MN*
mountain valley	*MV*
notch	*NO*
paha	*PA*
peak	*PK*
pediment	*PE*
plain (plural = Landscape)	*PN*
plateau (also Landscape)	*PT*
ridge	*RI*
rim	*RJ*
rock pediment	--
scarp	*RY*
scarp slope	--
scree slope	--
slick rock (also Microfeature)	--
spur	*SQ*
stack [geom]	*SR*
talus cone	--
talus slope	--
tor	*TQ*
valley	*VA*
valley floor remnant	--
wind gap	*WG*

Microfeatures:

finger ridge	--
mound	*M*
rib	--
rill	--
slick rock (also Landform)	--

12. EROSIONAL – related dominantly to water erosion but excluding perennial, channel flow (i.e. fluvial, glaciofluvial), or eolian erosion.

Landscapes:

badlands	*BA*	mountains	*MO*
breaks	*BK*	piedmont	*PI*
canyonlands	--	piedmont slope	--
foothills	*FH*	plateau (also Landscape)	*PT*
hills	*HI*	tableland	*TB*
mountain range	--		

Landforms:

ballena	*BL*	notch	*NO*
ballon	*BV*	paha	*PA*
basin floor remnant	*BD*	partial ballena	*PF*
beveled base	--	peak	*PK*
canyon bench	--	pediment	*PE*
col	*CL*	plateau (also Landscape)	*PT*
colluvial apron	--	rock pediment	--
cuesta	*CU*	saddle	*SA*
cuesta valley	--	scarp slope	*RS*
eroded fan remnant	--	slick rock (also Microfeature)	--
eroded fan-remnant sideslope	--	stack [geom]	*SR*
erosion remnant	*ER*	strike valley	--
free face (also Geom. Comp. – Hills, Mountains)	*FW*	structural bench	*SB*
gap	*GA*	tor	*TQ*
hogback	*HO*	valley border surfaces	--
inselberg	*IN*	valley floor remnant	--
monadnock	*MD*	wind gap	*WG*
		window	--

Microfeatures:

earth pillar	--	pinnacle	--
finger ridge	--	rib	--
groove	--	rill	--
gully	--	slick rock (also Landform)	--
hoodoo	--	swale	--

13. DEPRESSIONAL (low area or declivity features, excluding permanent water bodies).

Landscapes:

basin	*BS*
basin floor (also Landform)	--
bolson	*BO*
semi-bolson	*SB*
valley	*VA*

Landforms:

alluvial flat	*AP*
basin floor (also Landscape)	*BC*
basin floor remnant	*BD*
box canyon	--
canyon	*CA*
closed depression (also Microfeature)	--
col	*CL*
coulee	*CE*
cove [geom.]	*CO*
cuesta valley	--
depression	*DP*
drainageway	*DQ*
drainhead complex	-
gap	*GA*
gorge	*GO*
gulch	*GT*
gut (valley)	*GV*
intermontane basin	*IB*
kettle	*KE*
mountain valley	*MV*
open depression (also Microfeature)	--
playa	*PL*
playa floor (also Microfeature)	--
playa rim (also Microfeature)	--
playa slope (also Microfeature)	--
playa step (also Microfeature)	--
pothole (intermittent water; also Microfeature)	*PH*
ravine	*RV*
saddle	--
sag (also Microfeature)	--
semi-open depression	--
slot canyon	--
strike valley	--
swale (also Microfeature)	*SC*
trough	*TR*
U-shaped valley	*UV*
valley	*VA*
valley floor	*VL*
V-shaped valley	*VV*

Microfeatures:

closed depression (also Landform)	--
open depression (also Landform)	--
playa floor (also Landform)	--
playa rim (also Landform)	--
playa slope (also Landform	--
playa step (also Landform)	--
pothole (intermittent water; also Landform)	--
swale (also Landform)	--
tree-tip pit	--

14. WETLANDS - [Related to vegetated and / or shallow wet areas, and wet soils. Provisional list: conventional, geologic definitions; not legalistic or regulatory usage].

Landscapes:

estuary (also Landform)--
everglades --

[generally, there is no appropriate Landscape term for wetlands; by default, choose the most appropriate Landscape term from another Process Environment or Other Grouping]

Landforms:

alas *AA*
backswamp *BS*
bog *BO*
Carolina Bay *CB*
dune slack (also Microfeature) --
ephemeral stream (also Microfeature) --
estuary (also Landscape) *WD*
fen *FN*
flood-plain playa *FY*
fringe tidal marsh --
highmoor bog *HB*
intermittent stream (also Microfeature) --
lowmoor bog *LX*
mangrove swamp --
marsh *MA*
mud flat *MF*
muskeg *MX*
oxbow lake (ephemeral water) *OL*
peat plateau *PJ*
playa (intermittent water) *PL*
pocosin *PO*
pothole (intermittent water; also Micro.) *PH*
raised bog *RB*
ribbed fen *RG*
salt marsh *SM*
slough (intermittent water) *SL*
string bog *SY*
swamp *SW*
tidal flat *TF*
tidal marsh --

Microfeatures:

dune slack (also Landform) --
ephemeral stream (also Landform) --
intermittent stream (also Landform) --
playette --
pothole (intermittent water; also Landform)--
vernal pool (seasonal water) --

15. WATER BODIES - Discrete "surface water" features, primarily permanent open water, which in Soil Survey Reports are commonly treated as the generic map unit "water" (e.g. lake), or as a spot / line symbol (e.g., perennial stream).

Landscapes:

bay [coast] (water body; also Landform) --
estuary (water body; also Landform) --
lagoon [coast] (water body; also Landform) --

Landforms:

axial stream --
bay [coast] *WB*
bayou *WC*
cove [coast] --
dune lake --
estuary *WD*
fjord *FJ*
glacial lake *WE*
gulf [coast] --
gut [stream] *WH*
ice-marginal stream --
inlet --
lagoon (water body; also Landscape) *WI*
lagoon channel --
lake *WJ*
marine lake (water body) --
ocean --
oxbow lake *WK*
perennial stream (also Microfeature) --
playa lake *WL*
pluvial lake *WM*
pothole (lake) (also Micro.) *WN*
proglacial lake *WO*
relict-tidal inlet (water body) –
river --
sag pond (also Microfeature) --
salt pond (also Microfeature) *WQ*
sea --
shoal *WR*
slackwater *WS*
slough (permanent water) *WU*
sound --
strait --
stream (permanent water) --
tarn (also Microfeature) --
thermokarst lake *WV*
tidal inlet --
tunnel-valley lake --

Microfeatures:

channel (permanent water) --
perennial stream (also Landform) --
pond --
pool --
pothole (permanent water; also Landform) --
sag pond (also Landform) --
salt pond (also Landform) --
tank --
tarn (also Landform) --

16. SUBAQUEOUS FEATURES [Discrete, relatively shallow underwater features that commonly can support rooted plants, and adjacent features, ordinarily found below permanent open water. Historically, in Soil Survey Reports these underwater features have been included in the generic map unit "water"].

Landscapes:

bay [coast] (water body; also Landform) --
?? gulf [coast] (water body) --
estuary (water body; also Landform) --
lagoon [coast] (water body; also Landform) –
?? ocean (water body) --
?? sea (water body) --
?? sound (water body) --
?? strait (water body) --

Landforms:

barrier cove	--
bay [coast] (water body; also Landscape)	--
bay bottom	--
cove [coast]	--
dredged channel *(Anthropogenic Feature)*	--
dredge-deposit shoal *(Anthro. Feature)*	--
estuary (water body; also Landscape)	*WD*
flood-tidal delta	--
flood-tidal delta flat	--
flood-tidal delta slope	--
fluviomarine bottom	--
inlet	--
lagoon [coast] (water body; also Landscape)	*WI*
lagoon bottom	--
lagoon channel	--
? lake	*WJ*
mainland cove	--
marine lake	--
reef	*RF*
relict-tidal inlet	--
shoal	--
submerged back-barrier beach	--
submerged mainland beach	--
submerged point bar [coastal]	--
submerged wave-built terrace	--
submerged wave-cut platform	--
tidal inlet	--
washover-fan flat	--
washover-fan slope	--

Microfeatures:

channel (permanent water)	--

Exhibit 629-2 List of Materials or Material-Related, Structure, or Morphological-Feature Terms Contained in the Glossary.

(**NR** - indicates terms that are NOT RECOMMENDED; **NP** - indicates terms that are NOT PREFERRED)

`a`a lava
ablation till
alluvium
anticline
aquiclude
aquifer
aquitard
ash
ash flow
backswamp deposit
basal till
beach sands
bed
bedded
bedding plane
bedrock
block
block lava
block field
block glide deposit
block stream
blue rock [volcanic]
bombs [volcanic]
boulder field - NR
bowl
breccia
buried soil
caliche
caprock
chert
chimney
cinders
clast
clastic
coastal marl
colluvium
complex landslide deposit
conglomerate
continuous permafrost
coprogenous earth
coprogenous material
country rock
craton
creep deposit
cross-bedding
cross-lamination

cross-stratification
cryptogamic crust
cryoturbate
cyclothem
dead-ice - NR
debris
debris avalanche deposit
debris flow deposit
debris slide deposit
deposit
desert pavement
desert varnish - NP
detritus (geology)
diamictite
diamicton
diatomaceous earth
dike
dip
discontinuity
discontinuous permafrost
dropstone
dolomite (mineral)
dolomite (rock)
dolostone - NR
dome
dredge spoils
drift (glacial geology)
earthflow deposit
eolian deposit
epiclastic
erosional pavement
erratic
estuarine deposit
facies (stratigraphy)
fanglomerate
felsenmeer - NP
felsic rock
fill
fly ash
flowtill
fluviomarine deposit
fold
formation (stratigraphy)
freshwater marl
glacial drift - NR
glacial outwash - NR
glacial till - NR
glaciofluvial deposits
glaciolacustrine deposits
glaciomarine deposits
glauconite pellets
graben
greensands
ground soil
grus
herbaceous peat
horst
ice-pushed ridge
ice wedge
ice wedge cast
igneous rock
interbedded
intrusive
lacustrine deposit
lagoonal deposit
lahar
lamella
lamina
lamination - NR
lapilli
lateral spread deposit
lava flow
limestone
lithologic
lodgment till
loess
louderback
mafic rock
marine deposit
marl
melt-out till
metamorphic rock
metasediment
microbiotic crust
mine spoil, coal extraction
mine spoil, metal-ore extraction
mine spoil or earthy fill
moraine
moss peat
muck
mucky peat
mudstone
mudflow deposit
nueé ardente
outcrop
outwash
overbank deposit
overburden
overthrust
paleosol
pahoehoe lava
parna
peat
pedisediment
permafrost
pillow lava
pitted outwash
pluton
plutonic
porcellanite
puff [gilgai]
pumice
pyroclastic
regolith

relict soil
residuum
rhythmite
rockfall deposit
rockfall avalanche deposit
rockfall landslide deposit
rock varnish
rotational landslide deposit
rubble
sand sheet
sandstone
saprolite
scoria
scree
sediment
sedimentary peat
sedimentary rock
shale
siltstone
sill
slide
slip face
slip surface
slope alluvium
sloughed till - NR
slump - NR
slump block
slump till
soil fall deposit
solifluction sheet
spoil bank
spoil pile
sporadic permafrost
stagnant ice
stone line
strandline
subglacial till
subglacial melt-out till
supraglacial till
supraglacial debris-flow sediment - NP
supraglacial melt-out till - NP
supraglacial till - NP
syncline
talus
tephra
thaw-sensitive permafrost
thaw-stable permafrost
till (glacial)
tombolo
topple deposit
tor
tuff
valley fill
valley side alluvium
varve
ventifact
vitric
volcanic breccia
volcaniclastic
welded soil
welded tuff
woody peat

Exhibit 629-3 Genesis - Process Terms and Geologic Time Terms Contained in the Glossary.

(**NR** - indicates terms that are NOT RECOMMENDED; **NP** - indicates terms that are NOT PREFERRED).

aeolian - NR
accretion
active layer
active slope - NR
aggradation
alluvial
angle of repose
avalanche
avulsion
backwearing
block glide
buried
bypassed
cat clay - NR
colluvial
competence
complex landslide
conformity
congelifraction - NP
congeliturbation - NR
constructional (geomorphology)
corrosion
creep
cryoplanation
cryoturbation
cut and fill
debris avalanche
debris flow (mudflow)
debris slide
deflation
degradation
deposition
destructional (geomorphology)
dip [structural geol.]
discontinuity
distal
earthflow
Eocene
eolian
erosion
erosional (geomorphology)
exfoliation
exhumed
extramorainic - NP
extramorainal
extrusive
fall
flow
fluvial
frost bursting - NR
frost churning - NR
frost riving - NR
frost shattering
frost splitting - NR
frost stirring - NR
frost weathering - NR
frost wedging - NR
geomorphology
gelifraction - NR
gelivation - NR
glacial
glacial epoch
glacial marine sedimentation
glacial outburst flood (see *jokulhlaup*)
glaciation
Holocene
ice age - NR
ice-rafting
ice segregation
intramorainal
joint
knickpoint
landslide
lateral spread
lithification
mass movement
mass wasting – NP
metastable slope - NR
Miocene
mudflow
nivation
Oligocene
Paleocene
pedoturbation
periglacial
Pleistocene
Pliocene
postglacial - NP
proximal
Quaternary
recent
relict
rockfall
rockfall avalanche
rotational landslide
sand flow
scour
scour and fill
slide
slope wash
slump - NP
soil creep - NP

soil fall
solifluction
strike [structural geol.]
subaerial
subaqueous
storm surge
stratified
stratigraphy
stream order
subaerial
subglacial
superglacial - NP
Tertiary
topple
translation slide
volcanic
weathering
welding

Exhibit 629-4 North American Glacial Episodes and General Geologic Time Scale.

(Schoeneberger, et al, 2002; After Morrison; In: Sibrava, et al., 1986; and Harland, et al., 1990)

Geologic Period	Geologic Epoch	Sub-Division	O Isotope Stage [2]	Years (BP)
QUATERNARY	**Holocene**		(1)	0 to 10-12 ka*
	Late Pleistocene	Late Wisconsin	(2)	10-12 to 28 ka
		Middle Wisconsin	(3, 4)	28 to 71 ka
		Early Wisconsin	(5a - 5d)	71 to 115 ka
		Late Sangamon Sangamon	(5e)	115 to128 ka
	Pleistocene	Late – Mid Pleistocene *(Illinoian)*	(6 - 8)	128 to 300 ka
	Middle Pleistocene	Middle – Mid Pleistocene	(9 - 15)	300 to 620 ka
		Early – Mid Pleistocene	(16 - 19)	620 to 770 ka
	Early Pleistocene			770 ka to 1.64 Ma**
TERTIARY	**Pliocene**			1.64 to 5.2 Ma
	Miocene			5.2 to 23.3 Ma
	Oligocene			23.3 to 35.4 Ma
	Eocene			35.4 to 56.5 Ma
	Paleocene			56.5 to 65.0 Ma
CRETACEOUS	*Late Cretaceous*			65.0 to 97.0 Ma
	Early Cretaceous			97.0 to 145.6 Ma
JURASSIC				145.6 to 208.8 Ma
TRIASSIC				208.8 to ≈ 243.0 Ma
PERMIAN				≈ 243.0 to 290.0 Ma
PENNSYLVANIAN				290.0 Ma to 322.8 Ma
MISSISSIPPIAN				322.8 to 362.5 Ma
DEVONIAN				362.5 to 408.5 Ma
SILURIAN				408.5 to 439.0 Ma
ORDIVICIAN				439.0 to 510.0 Ma
CAMBRIAN				510.0 to ≈ 570.0 Ma
PRECAMBRIAN				> ≈ 570.0 Ma

* ka = x 1,000; ** Ma = x 1,000,000

≈ = "approximately"

[1] Modified from Morrison, 1991; Sibrava, et al., 1986; and Harland, et al., 1990.

[2] Oxygen isotope.

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Sibrava, V., D.Q. Bowen, and D.Q. Richmond (eds.). 1986. Quaternary glaciations in the Northern Hemisphere: final report of the International Geological Correlation Programme, Project 24. Quaternary Science Reviews, Vol. 5, Pergamon Press, Oxford. 514 p.

Exhibit 629-5 Till Terms.

TILL TERMS

Genetic classification and relationships of till terms commonly used in soil survey. (Schoeneberger, et al., 2002; adapted from Goldthwaite and Matsch, 1988.)

Location (Facies of tills grouped by position at deposition)	**Till Types**	
	Terrestrial	**Waterlaid**
Proglacial Till (at the front of, or in front of **a glacier**)	proglacial flowtill	waterlaid flowtill
Supraglacial Till (on top of, or within upper part of a glacier)	supraglacial flowtill [1, 3] supraglacial melt-out till [1] (ablation till - NP) [1] (lowered till - NP) [2] (sublimation till - NP) [2]	--------------
Subglacial Till (within the lower part of, or beneath a glacier)	lodgment till [1] subglacial melt-out till subglacial flowtill (= "squeeze till" [2, 3]) (basal till - NP) [1] (deformation till - NP) [2] (gravity flowtill - NP) [2]	waterlaid melt-out till waterlaid flowtill iceberg till (= "ice-rafted")

[1] *Ablation till* and *basal till,* generic terms that only describe "relative position" of deposition, have been widely replaced by multiple, more specific terms that convey both relative position and process. *Ablation till* (any comparatively permeable, non-sorted debris deposited within or above stagnant ice) is replaced by *supraglacial melt-out till*, *supraglacial flowtill*, etc. *Basal till* (any dense, non-sorted, subglacial till) is replaced by *lodgement till*, *subglacial melt-out till*, *subglacial flowtill*, etc.

[2] Additional (proposed) till terms that have not gained wide acceptance, and are therefore considered to be *Not Preferred*, and should not be used (shown for completeness).

[3] Also called *gravity flowtill* (Not Preferred).

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Exhibit 629-6 Pyroclastic Terms.

PYROCLASTIC TERMS: Size and compositional relationships of pyroclastic terms commonly used in soil survey. (Schoeneberger, et al., 2002; adapted from Fisher, 1989.)

<table>
<tr><th colspan="4">Pyroclasts and Pyroclastic Deposits (Unconsolidated)</th></tr>
<tr><td colspan="4">Size Scale: 0.062 mm [1] | 2 mm | 64 mm [1] |</td></tr>
<tr><td colspan="4"><—— tephra ——>
(<i>all ejecta</i>)</td></tr>
<tr><td colspan="2"><—— ash ——></td><td rowspan="2"><– cinders [2] –>
(<i>specific gravity > 1.0 & < 2.0</i>)</td><td rowspan="2"><–– bombs [2] ––>
(<i>fluid-shaped coarse fragments</i>)</td></tr>
<tr><td><——>
fine ash</td><td><——>
coarse ash</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td><–– lapilli [2] –>
(<i>specific gravity > 2.0</i>)</td><td><–– blocks [2] ––>
(<i>angular-shaped coarse fragments</i>)</td></tr>
<tr><td colspan="2"><—— scoria [2] ——>
(<i>slightly to moderately vesicular; specific gravity > 2.0</i>)</td></tr>
<tr><td></td><td><——>
pumiceous ash [3]</td><td colspan="2"><—— pumice [2] ——>
(<i>highly vesicular; specific gravity < 1.0</i>)</td></tr>
<tr><th colspan="4">Associated Lithified (Consolidated) Rock Types</th></tr>
<tr><td><——>
fine tuff [1]</td><td><——>
coarse tuff [1]</td><td>< lapillistone [1] >
(sp. gr. > 2.0)</td><td>< –pyroclastic breccia–></td></tr>
<tr><td colspan="2"><–– welded tuff ––></td><td colspan="2"><—— agglomerate ——>
(<i><u>rounded</u>, volcanic coarse fragments</i>)</td></tr>
<tr><td colspan="2"><–– ignimbrite ––>
(<i>ash-dominated</i> <i>flows and nuee ardentes</i>)</td><td colspan="2"><—— volcanic breccia ——>
(<i><u>angular</u>, volcanic coarse fragments</i>)</td></tr>
</table>

[1] These size breaks are taken from geologic literature (Fisher, 1989) and based on the modified Wentworth scale. The 0.062 mm break is very close to the USDA's 0.05 mm break between *coarse silt* and *very fine sand* (Soil Survey Staff, 1993). The 64 mm "geologic" break is relatively close to the USDA's 76 mm break between *coarse gravel* and *cobbles*. (See the chart "Comparison of Particle Size Classes in Different Systems" in the "Profile / Pedon Description Section" under "Soil Texture" in the Field Book for Describing and Sampling Soils (Schoeneberger, et al., 2002).

[2] A minimum size limit of 2 mm is required in Soil Taxonomy (Soil Survey Staff, 1994; p. 54), but is not required in geologic usage (Fisher, 1989).

[3] The descriptor for pumice smaller than 2 mm, as used in Soil Taxonomy (Soil Survey Staff, 1999). Geologic usage is based solely upon composition and does not include any size restrictions;.

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Part 630 - BENCHMARK SOILS

CONTENTS

Part 630 - BENCHMARK SOILS

630.00 Definition and Purpose.

(a) Definition.

A benchmark soil is one of large extent, one that holds a key position in the soil classification system, one for which there is a large amount of data, or one that has special significance to farming, engineering, forestry, ranching, recreational development, urban development, wetland restoration, or other uses. The cost of investigation and the large number of combinations of soil uses and management practices preclude laboratory and field studies of all soils; therefore, studies of benchmark soils are essential. A benchmark soil represents other soils. Knowledge of the properties and behavior of benchmark soils contributes to the understanding and interpretation of other soils with similar properties. This knowledge is important to soil technology and the use of soil surveys.

(b) Purpose.

Benchmark soils help to focus the investigative effort on soils that have the greatest potential for extending collected data and resultant interpretations to other soils. Lists of benchmark soils are useful in planning many kinds of soil studies.

(c) Use.

Example uses for benchmark soils:

- assessing conservation effects
- evaluating soil interpretations
- studying macro/micronutrient and trace elements
- monitoring dynamic soil property changes
- measuring saturated hydraulic conductivity
- determining soil quality
- verifying and testing soil erodibility factors
- collecting crop and range plant adaptation and yields
- assessing soil fertility
- locating sources for training materials and onsite training activities
- modeling crop/soil/pesticide scenarios for surface water and groundwater assessments
- modeling pedotransfer functions

(d) Access to Benchmark Soil List.

Use the on-line Soil Series Classification (SC) or Official Soil Series Descriptions (OSD) data access search routines to access and sort benchmark soils. These files are on the soils Web site by selecting View OSD by Query at http://soils.usda.gov/technical/classification/osd/index.html or by selecting Create Report by Query at http://soils.usda.gov/technical/classification/scfile/index.html.

630.01 Policy and Responsibilities.

(a) The MLRA office is responsible for:

- exchanging information on benchmark soils with state offices,
- maintaining the benchmark status of soil series in the soil classification database,

- maintaining a file of data for benchmark soils that are on the major land resource area list,
- coordinating benchmark soils with the state soil scientist in states that share the major land resource area, and
- focusing long-range soil survey investigation plans on benchmark soils and their characteristics.

(b) The state soil scientist is responsible for:
- proposing changes and additions to the benchmark soil list,
- ensuring input from cooperators and interdisciplinary specialists in the selection of benchmark soils, and
- encouraging the use of benchmark soils in organizing and planning research by state agricultural experiment stations and other agencies.

(c) The National Soil Survey Center is responsible for:
- providing guidance in the selection of benchmark soils,
- assuring that internet access and query routines for benchmark soils are available to researchers in experiment stations, highway departments, and other organizations,
- performing laboratory characterization, and
- maintaining the laboratory database.

(d) The National Geospatial Development Center is responsible for:
- developing Web-based geospatial analysis tools for use in analyzing and revising benchmark soils by major land resource area, and
- developing Web-based map display products.

630.02 Criteria for Selecting or Revising Benchmark Soils.

(a) Criteria.

The soil series that represent the range of soil conditions within a major land resource area serve as benchmark soils. The criteria are:

(1) Extent. The soil series that are selected as benchmark soils are commonly of large extent (>100,000 acres) in the Land Resource Region (LRR), and of moderate or large extent in the major land resource area (> 10,000 acres). Not all series of moderate or large extent are benchmark soils. Generally, the combined total extent of benchmark soils should comprise about 20 to 25 percent of the total soil area of the major land resource area. Since benchmark soils represent the soil series in classes of the higher categories of soil taxonomy, the soils selected as benchmark should collectively be considered representative of 60 to 80 percent of all soils in the major land resource area. This kind of representation ensures that any collected data are widely applicable.

(2) Key soils. Certain soils occupy key positions in soil taxonomy, and research on these can be easily applied to other soils. Benchmark soils represent the extensive soil series in classes of the higher categories of the soil classification system. They typically do not share the same family.

(3) Important soils. Certain soils are especially important because of their use for specialty crops or engineering purposes. If these soils are essential to the understanding of and interpretations for specialty crops, engineering, or other uses, they become benchmark soils. The number of these soils is small, perhaps two or three per major land resource area.

(4) Existing data. Soil series for which there are large amounts of data have preference over equally suitable series for which there are less data. Data-completeness of correlated pedon data must be evaluated concurrently with analyses of series extent and taxonomic significance. The national soil characterization database, maintained by the National Soil Survey Center, includes laboratory data for benchmark soils. In addition, soil survey investigations reports identify benchmark soils. This will optimize the identification of potential benchmark candidates.

(b) General Guidance.

Select the fewest number of soils required to adequately reflect the criteria. The number of benchmark soils in a major land resource area varies according to the size of the area and the diversity and complexity of soils. In highly diverse and complex major land resource areas, do not construct a benchmark list solely on the basis of soil series extent. An unmanageable number of benchmark soils may otherwise result. Oftentimes, many of the series share the same taxonomic family and are expected to behave similarly. Therefore, there is little advantage in assigning more than one series from a given family as a benchmark soil. Instead determine which series is most representative for the family, and assign benchmark status to that series only (e.g., dominant extent or the series having the most complete laboratory dataset). This will keep the number of benchmark soils in the major land resource area relatively small and minimize research expenditures.

630.03 Maintaining a Record of Benchmark Soil Data Needs.

(a) Maintenance.

Soil surveys are dynamic; consequently the adequacy of the current benchmark soils status needs to be evaluated during any maintenance activity. Evaluate benchmark soils status at any time, regardless of whether active soil surveys are being conducted. There is no automated procedure for evaluating and revising the current list of benchmark soils. Make judgments in deciding which key taxonomic positions are represented as benchmark, and which similar soils in closely related classes are associated with the benchmark soil.

(b) Development of a Comprehensive Report.

Each MLRA office leader, in consultation with the state soil scientists and research institutions, develops a comprehensive report of the kinds of data and information available and needed to predict the behavior of soils in each major land resource area. This report compares existing data and information on benchmark soils with needs to determine the adequacy of information for the major land resource area. This comparison helps plan for studies of soil properties, qualities, and behavior.

(c) Narrative Record of Each Benchmark Soil.

Based on the comprehensive report, a narrative record of each benchmark soil is provided to state soil scientists for distribution. The record helps to facilitate long range planning and to encourage cooperative ventures with research institutions. Discuss the kinds of special studies and soil properties needed. Include literature references of research studies on the benchmark soil. Refer to Exhibit 630-1 for an example of a narrative record.

Exhibit 630-1 Sample Narrative Record for Benchmark Soils.

BETA SERIES – a member of the fine-loamy, mixed, superactive, frigid Typic Argiustolls family. It dominantly occurs in the Rolling Soft Shale Plains, Major Land Resource Area (MLRA) 54, but it also extends into the Southern Dark Brown Glaciated Plains, MLRA 53C. The Beta series is about 105,000 acres in extent.

Beta soils are 100 to 150 centimeter deep to soft bedrock and formed in material weathered from sandstone, siltstone, and shale.

Information needs: In MLRA 54, knowledge of the properties, qualities, and behavior of the Beta soils is useful in understanding (1) the effect of cropping systems and management practices on dynamic soil property change, (2) the penetration of roots and the movement of water into the soft bedrock, (3) pesticide and nutrient fate and transport for surface water and groundwater assessment, (4) the use of soils with soft bedrock for septic tank absorption fields, (5) the Silty range site, (6) and the use of soils with soft bedrock for building sites. The Beta soils are underlain by strippable coal, and the knowledge of soil properties, qualities, and behavior is important for the development of effective soil reclamation measures.

Data needs: The following dynamic properties and morphological attributes are needed across the common crop management systems: saturated hydraulic conductivity, soil bulk density, organic carbon, surface roughness, consistence, structure, and macropore characteristics (geometry, frequency, distribution, and continuity). The purpose is to integrate the macropore characteristic with structure, particle-size distribution, and mineralogy in order to develop a pedotransfer function that predicts saturated hydraulic conductivity.

Laboratory data:

NRCS NSSC Soil Characterization Database:

User Pedon ID
82STATEFIPS031005
84STATEFIPS021002
87STATEFIPS005001
91STATEFIPS007007
97STATEFIPS013011

ANYSTATE University pedon data
(List sources and contacts where information can be acquired)

Part 631 - SOIL SURVEY INVESTIGATIONS

CONTENTS

631.00 Definition and Purpose.

Soil survey investigations are activities that develop and provide reliable new information and understanding about soils, soil relationships, and soil survey methods. Soil survey investigations:

- supplement field information with laboratory and analytical data on the properties and behavior of soil;
- develop field and laboratory methods;
- provide a database of soil information;
- provide concepts, methods, understanding, and predictions for soil survey interpretations and modeling; and
- develop and provide theories and understanding to soil formation and the relationship of soils to genetic and landscape factors.

631.01 Policy and Responsibilities.

(a) The Natural Resources Conservation Service (NRCS) has authorization for research in support of soil survey activities. Soil survey researchers of the NRCS coordinate with field, state soils staffs, and State conservationists of NRCS and partners of the National Cooperative Soil Survey (NCSS). Investigations primarily focus on the soils of the United States, Puerto Rico, and trust territories. Researchers working in other countries coordinate with the NRCS International Conservation Division and the USDA Office of International Cooperation Division of the Foreign Agricultural Service.

(b) Investigations by the National Soil Survey Center respond to requests from NRCS MLRA or State offices, other branches of the NRCS, and other organizations. The National Soil Survey Center initiates some projects to advance the NCSS program.

(c) The National Soil Survey Center is responsible for:

-- leadership in regional and national research projects for soil surveys,
-- leadership in the federal research program in pedology,
-- manuals on laboratory procedures,
-- training for field investigations, and
-- the soil survey laboratory databases.

(d) The MLRA office is responsible for:

- approval of field soil survey investigations,
- attribute data in the National Soil Information System,
- identifying data voids,
- coordinating work plans with cooperators,
- requesting National Soil Survey Center assistance,
- ensuring complete and accurate pedon descriptions and the index for soil characterization samples and
- updating the classification of pedons in the National index.

(e) The project leader is responsible for:

- complete and accurate pedon descriptions and classification of soils on sampling projects within the project area.

631.02 Kinds of Projects.

(a) Laboratory Characterization Projects.

(1) Characterization projects define the morphological, chemical, physical, and mineralogical properties of soils within a major land resource area. The data are included in soil survey reports at the discretion of the MLRA office team leader.

(2) Characterization projects usually include suites of standard laboratory analyses, which are defined in part 631.03(a).

(3) Laboratory characterization projects **require** work plans for the major land resource area. Exhibit 631-5 provides an example of a characterization work plan. The work plan identifies pedons and laboratory data that may be published in the soil survey.

(b) Research Projects.

(1) Research define soil data relationships, soil genetic processes, soil-landscape relationships, soil interpretive applications, or criteria for soil classification. Research projects normally combine field observations and laboratory or special field analyses. Some projects examine existing data to reveal new data relationships or applications.

(2) An outline of the objectives, hypotheses, and methods of study for research projects reduces the complexity and helps report the results to other scientists.

(3) Research projects require work plans. Exhibit 631-3 gives an example of a research project work plan checklist, and Exhibit 631-4 gives an example work plan.

(c) Laboratory Reference Projects.

(1) Reference projects answer a single question or at most very few questions, directed at quick analyses such as on particle-size class, base saturation, or mineralogy.

(2) Reference projects require basic documentation, including pedon descriptions, but do not require work plans.

(d) Other Kinds of Projects.

Other projects or services include landform and geomorphic studies, ground penetrating radar, other special measurements, extraction of information from the laboratory database, and literature searches.

Liaisons and others at the National Soil Survey Center answer technical questions and help develop plans for a state, major land resource area, or other land area.

The National Soil Survey Center staff cooperates on various projects with visiting scientists, including NRCS soil scientists. Studies by major land resource area, including soil survey updates, are an example.

Listings of existing data for the area of interest are available and should be obtained prior to requesting additional data-gathering projects.

631.03 Laboratory Investigation Methods.

(a) Standard Analyses.

Standard laboratory analyses include chemical, physical, and mineralogical analyses for classification of soils within Soil Taxonomy. Analyses also answer specific questions relating to soil survey interpretations and soil performance. The more routine analyses include particle-size, cation exchange capacity, base saturation, organic carbon, pH, calcium carbonate equivalent, salt, bulk density, water retention, and clay mineralogy.

Laboratory analyses follow standards described in Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual. Only the laboratory data from standard analyses enters the permanent Soil Survey Laboratory Database. Method codes identify the analytical method for these analyses.

(b) Special Analyses.

Some chemical, physical, and mineralogical analyses answer specific requests from states for conservation activities or to test new methods. Recurring requested analyses may become standard. Special analyses include published procedures used by other laboratories that have been developed or adapted by the Soil Survey Laboratory.

(c) Soil Sampling and Analysis.

(1) A soil horizon is the primary sampling unit. For all characterization projects and some reference projects, all horizons to 2 meters are sampled unless hard bedrock (lithic contact) is at a lesser depth. The project work plan identifies the pedons to be sampled and analyses to be made.

(2) The soil survey project office locates pedons for sampling that represent the soils and conditions of concern. Large excavations facilitate sampling. The sampling team records site data, including geomorphic information, vegetation, land use, and pedon description data before soil sampling begins.

(3) Most laboratory analyses use air-dry bulk samples that are screened through a 2-mm sieve. Bulk samples need to be large enough to represent the proportion of rock fragments up to 20 mm (3/4 in.) in diameter and to provide at least one quart of material less than 2 mm in diameter. Proportions of rock fragments larger than 20 mm (3/4 in.) in diameter are estimated by volume or by a combination of weight and volume in the field. Bulk density and moisture retention determinations require clod samples which preserve the field configuration of pore space. The Soil Survey Laboratory has detailed information on pedon sampling.

(4) The project objectives determine the analyses. The local and laboratory project coordinators jointly refine the objectives. Sampling protocol and standard laboratory analytical methods may be referenced in the Soil Survey Laboratory Methods Manual.

(5) The Soil Survey Laboratory, upon request, provides sampling equipment and supplies, such as bags, tags, shipping documents, saran for coating clods, clod boxes, etc., for sampling soils that are to be sent to the laboratory. The National Soil Survey Center budgets costs for analyses and assistance for projects with NRCS and NCSS cooperators based on available funding and workload requests.

631.04 Field Investigation Methods.

(a) Landscape and Geomorphic Studies.

(1) Geomorphic studies use standard geologic methods and concepts of geomorphic surfaces to understand the relations among soils and the various parts of the landscape. Geomorphic surfaces can identify landscape elements that share a common geologic time component and can establish how different landforms and their materials relate to each other.

(2) Field investigations of soil-geomorphic relations require detailed studies of the surficial geology and geomorphology of a small area.. In the process, these patterns are related to the occurrence and distribution of soils.

(3) The four phases of a field investigation are (1) determining the surficial geology, such as deposits and stratigraphy, (2) identifying the geomorphic surfaces to help establish the landscape and time frame, (3) establishing spatial relations through elevation and distance control, and (4) relating soil patterns to geomorphic units.

(4) State Conservationists initiate field investigations with a request for technical assistance to the National Soil Survey Center, as described in part 631.06. Obtain local assistance through national soil survey cooperators, state geological surveys, and universities.

(b) Ground-Penetrating Radar and Electromagnetic Induction.

(1) Ground-penetrating radar (GPR) reveals differential transmission, reflectance, and attenuation of the radar signal within soil. It indicates the depth and horizontal continuity of objects, horizons, or layers below the soil surface. Observation depths range from less than a meter in clays to thirty meters in some sands.

(2) Ground-penetrating radar helps to evaluate small-scale patterns of soil variability and estimate the composition of soil map units. It evaluates the continuity of root-restricting layers, and reveals other features and patterns that are important for soil mapping but are not clearly related to surface features.

(3) Several NRCS state offices maintain ground-penetrating radar equipment and operators. The National Soil Survey Center staff applies ground-penetrating radar to characterize soils and soil variability, determine the depths to diagnostic soil horizons, map bedrock surfaces and fractures, profile geomorphic and stratigraphic features, profile organic deposits and estimate peat reserves, and detect buried utilities, hazardous waste containers, and artifacts. The National Soil Survey Center offers this service to the agency and cooperating groups.

(4) Electromagnetic induction estimates the electric conductivity of soil materials at variable depths below the soil surface. The electrical conductivity of soils is influenced by the type and concentration of ions in solution, the amount and type of clays in the soil matrix, the volumetric water content, and the temperature and phase of the soil water.

(5) Electromagnetic induction uses electromagnetic energy to measure the apparent conductivity of earthen materials. Values of apparent conductivity are seldom diagnostic, but lateral and vertical variations in these measurements help to infer changes in soil types and soil properties, depths to contrasting layers and bedrock, and the locations of buried cultural features. Interpretations of the data base on the identification of spatial patterns within data sets.

(6) Several NRCS state offices maintain electromagnetic induction or towed array resistivity devices and operators. The National Soil Survey Center staff applies this technology to characterize soils and soil variability for many purposes. These purposes include precision farming and high intensity soil surveys, assess the distribution of saline and sodium affected soils, locate and map contaminant plumes emanating from waste-holding facilities, filter strips, mine tailing ponds or landfills, locate buried artifacts and areas of disturbed soils, and select sampling or monitoring sites. The Center loans instruments and offers field assistance and training to the agency and cooperating groups.

(c) Other Special Measurements and Instrumentation.
The National Soil Survey Center offer other special equipment, such as electrical resistance blocks for water content and water suction, salinity meters, soil moisture and temperature sensors, and various permeameters for special investigations. Global positioning devices help document the locations of measurements. The center also provides simple, noncommercial methods to measure diverse properties, such as clod and crust rupture resistance, the near-surface bulk density of fragile soil materials, and roughness.

631.05 Investigations Planning.

(a) Objectives.
Work plans focus the question, identify the resources required, and schedule the necessary steps. Research and full characterization projects require a written work plan because of the complexity and duration of the project; the number and location of participants; the magnitude of time, funds, and other resources required; and the relationships of organizations.

(b) Planning Process.
(1) Project initiation.
Anyone within the NCSS or even from outside the NCSS may recognize the need and initiate an investigations project. The memorandum of understanding for a project soil survey often initiates projects. The soil survey project office may identify an investigations need as a survey progresses. Review of the laboratory data within the major land resource area may show gaps in information and consequently lead to an investigation project. State, regional, national, or international initiatives may also generate a need for special projects.

(2) Project definition.
A cooperative effort by several investigators from more than one agency may provide project objectives and background information. If projects are within a survey area, the project soil scientist and staff draft the objectives, background, and needs of the project.

(3) Scheduling and responsibilities.
The person who initiated the investigations usually is responsible for scheduling and arranging for resources that are required to conduct the investigation. This information is outlined in the project work plan. For reference projects, the time and nature of information needed are in letter or oral agreements. For small projects with analyses, the letter of transmittal accompanying the samples includes the necessary information. Send copies of correspondence to appropriate administrators and interested technical people.

(c) Work Plans.
Project work plans provide background information about the study area, survey project, scientific issues, resource relationships, or other concerns to identify the scope, objectives, and requirements. Work plans clearly specify the objectives, the needs, and the expected benefits. They assign responsibilities, estimate the resources needed, and outline how the results will be made available and used. Exhibits 631-3 and 631-4 show a checklist and example work plan for a research project. Exhibit 631-5 gives an example work plan for a characterization project.

631.06 Requesting Assistance.

Prior to the beginning of each fiscal year (usually by July 10), the National Soil Survey Center requests State conservationists to submit their needs for assistance for the following year. Responses to those requests allow the National Soil Survey Center to allot resources and plan travel. The project work plan is to accompany the submission. Project work plans should be coordinated with cooperators prior to submission. The laboratory returns the work plan to the originator with comments and suggestions before work is begun on the project.

For reference projects, the request for assistance may accompany the samples and confirmed orally or in writing through the liaisons.

All submissions of samples should include a list of the pedons and horizons sampled and pedon descriptions. It is desirable to have a statement of the problem and any time constraints that one may have.

(c) Informal Discussion of Technical Assistance.
Liaisons for the National Soil Survey Center to the various MLRAs or states and other staff members are available for the discussion, planning, and development of proposals for technical assistance on an informal basis at any time.

631.07 Laboratory Databases.

(a) Soil Survey Laboratory Database.
The Soil Survey Laboratory database, located in Lincoln, Nebraska, currently contains data for more than 23,000 pedons from analyses performed at the Soil Survey Laboratory and from the three pre-existing NRCS laboratories (at Riverside, Beltsville, and Lincoln). The laboratory adds data from more than 600 pedons annually. Customers may access the data through the National Soil Characterization Database, (http://soils.usda.gov/soil_survey/nscd/main.htm) or CD-ROM. Access to the indexed data through the online database is by state and county, by major land resource area(s), by classes of soil taxonomy, or by several other criteria.

(b) Input of Laboratory Data.
(1) The index of laboratory data allows for easy sorting of data available. The index only allows entry of data obtained by standard procedures. The index requires classification by soil series or family and a description of the site and pedon.

(i) For each pedon the index includes the pedon classification, latitude, longitude, map unit symbol, state, soil survey area, location of the sampled pedon, source of the data, kinds of analyses available, and other information. Exhibit 631-1 illustrates NRCS-SOI-8, Input Form for the Index of Soil Laboratory Data.

(ii) The MLRA office updates the file at anytime by sending an updated NRCS-SOI-8 to the Soil Survey Laboratory. The Soil Survey Laboratory assigns the computer record and pedon numbers and maintains the computer files and the index.

(2) Exhibit 631-2 provides instructions for completing the NRCS-SOI-8.

(i) At the time of sampling, the sampling team drafts a soil description. This description including location by latitude, longitude, MLRA, MOIST REGIME, SS AREA and field symbol accompany the soil samples to the laboratory.

(ii) The Soil Survey Laboratory generates several items on the NRCS-SOI-8. These are REC (01), STAT (02), PED NO (03), LAT (05), LON (06), SOURCE (11), SAMPLED AS (12), FIELD SYMBOL (13), LAB SAMPLE NUMBERS (14), STATE AND LABORATORY (15), SAMPLE (16), SOIL SURVEY SAMPLE NO (17) and all analyses counts (items 39-67), except item 42. Exhibit 631-2 provides an example. For the SOURCE (11), the data are considered unpublished when analyses are initially completed and distributed by the Soil Survey Laboratory. Later, if the data are published, the MLRA office updates the SOURCE (11). The choices for SAMPLE (16) may or may not be circled by the Soil Survey Laboratory because samples on hand may be discarded as a result of insufficient storage space. After the samples are analyzed and data reviewed, the Soil Survey Laboratory sends the data, NRCS-SOI-8, and review comments to the MLRA office.

(iii) The MLRA office completes or assures completion of several items on the NRCS-SOI-8. These are INIT MO/YR (04); LAT (05); LON (06); CURRNT NAME (07); DATE (08); PUB SYMBOL (09), if applicable; TAX CODE (10); MLRA (18); DATE CLASSIFIED (19); SS AREA (20); MOIST REGIME (21); REFERENCE CITATION (22); TAXONOMY CODES (23); and NOTE (31). The MLRA office returns the NRCS-SOI-8 to the Soil Survey Laboratory within 45 days. If changes are needed, the old data are lined out and the new data are entered above the old in red pen or pencil. The Soil Survey Laboratory enters the information in the Soil Survey Laboratory computer file and returns an updated NRCS-SOI-8 to the MLRA office.

(3) The records in the index may need amending, particularly the classification of the pedon analyzed (23 TAXONOMY CODES) and the date of the classification of the pedon or of any amendment of the classification (19 DATE CLASSIF). Only complete those items on the NRCS-SOI-8 that are to be amended. The MLRA office ensures the accuracy of the updated data, and the Soil Survey Laboratory verifies it.

(i) For changes in soil taxonomy, the MLRA office determines whether the revision affects the classification of pedons in the national index. If classification is affected, the MLRA office submits the necessary changes to the Soil Survey Laboratory for input.

(ii) The Soil Survey Laboratory completes an NRCS-SOI-8 as necessary to amend records already in the index. The laboratory sends these input forms to the MLRA office for review and for approval of the pedon classification. The MLRA office reviews the classification and returns the NRCS-SOI-8 to the Soil Survey Laboratory within 45 days.

(iii) The MLRA office for the state in which the pedon was sampled receives all other proposals for amendments. The MLRA office classifies the pedon, makes any corrections

Field Code Changed

Formatted

Deleted: http://www.statlab.iastate.edu/soils/ssl/natch_data.html needed on the NRCS-SOI-8, and sends it to the Soil Survey Laboratory.

Exhibit 631-1 NRCS-SOI-8 Input Form for the Index of Soil Laboratory Data.

S C S -- S O I L S -- 8 Ver. JUN91

N O X F BY: /

01 REC 02 STAT(Circle) 03 PED No 04 INIT MO/YR 05 LAT 06 LON

/ F L R T V S I M O T U

07 CURRENT NAME (Max 16) I 08 DATE 09 PUB SYMBOL 10 TAX CODE (Circle) 11 SOURCE (Circle)

\- S L C M O Y N U

12 SAMPLED AS (Max 16) L,T, V,P 13 FIELD SYMBOL 14 LAB SAMPLE NUMBERS 15 (STATE) LABORATORY (Circle) 16 SAMPLE (Circle)

\- - / / / /

S YR ST CO PEDON 18 MLRA 19 DATE CLASSIF 20 SS AREA (Max 4) 21 MOIST REGIME

17 SOIL SURVEY SAMPLE No

/ /

22 REFERENCE CITATION (Max 24) P U OR SO GG SGMOD PS MIN PH TEM OTH

23 T A X O N O M Y C O D E S

24 SUBGROUP MODIFIER (Max 28) 25 GREAT GROUP (Max 16)

26 PARTICLE SIZE FAMILY (Max 42) 27 MINERALOGY FAMILY (Max 30)

28 REACTION FAMILY (Max 14) 29 TEMPERATURE FAMILY (Max 16) 30 OTHER CHARACTERISTICS (Max 18)

31 NOTES: ________________ (Max 40)

SUMMARY OF KINDS AND AMOUNT OF ANALYSES AVAILABLE

KIND ANAL	AMT SUB	KIND ANAL	AMT
39= PS	5 PS, FRAGMENTS UNSPECIFIED	48=	-ELECTRICAL CONDUCTIVITY, RESISTIVITY, SALT
	6 PS, FRAGMENTS MEASURED		
	7 PS, FRAGMENTS ESTIMATED	49=	-SATURATION EXTRACT SOLUBLE, CATIONS & ANIONS
	8 PS, FRAGMENTS MEAS. & EST.		
		50=	-EXTRACTABLE IRON (PYROHOS, DITH-CIT, OXALATE)
40= BD	5 BULK DENSITY WITHOUT COLE		
	6 BULK DENSITY WITH COLE	51=	-CATION EXCHANGE CAPACITY
		52=	-ALUMINUM (PYROPHOS, KOH, DITH-CIT, NAOH, OXALATE)
41= MIN	5 CLAY FRACTION		
	6 SAND A/O SILT FRAC(S)	53=	-ATTERBERG LIMITS
	7 CLAY,SAND A/O SILT FRAC(S)	54=	-CLAY: CARBONATE OR FINE
	8 FAMILY MINERALOGY	55=	-FIBER
		56=	-GYPSUM (TOTAL)
42= HL	5 STANDARD ITEMS (MECHANICAL ANALYSIS & ATTERBERGS)	57=	-MINERAL CONTENT ORGANIC SOIL
		58=	-MANGANESE (ANY METHOD)
	6 STANDARD ITEMS & MAXIMUM DENSITY	59=	-NITROGEN
		60=	-PHOSPHOROUS (TOTAL)
	7 STANDARD ITEMS, MAXIMUM DENSITY, & SHRINK-SWELL	61=	-SULFUR (TOTAL)
		62=	-FIELD MEASURED WATER CONTENT OR TABLE, PERK RATE, ETC.
43=	- WATER CONTENT OR TENSIONS	63=	-THIN SECTIONS
44=	- ORGANIC CARBON OR MATTER	64=	-TOTAL ELEMENTAL ANALYSES
45=	- PH	65=	-HYDRAULIC CONDUCTIVITY
46=	- EXTRACTABLE CATIONS/BASES	66=	-AVAILABLE PHOSPHOROUS
47=	- CARBONATE	67=	-AVAILABLE POTASSIUM1

Exhibit 631-2 Instructions for Completing the NRCS-SOI-8 Input Form for the Index of Soil Laboratory Data.

The Soil Survey Laboratory assigns a computer RECORD number to all pedons that are entered in the national index. The Soil Survey Laboratory assigns a unique sequential PEDON NUMBER to identify pedons and to calculate record numbers for their computer files and for the Soil Laboratory Data Index.

To complete the NRCS-SOI-8, print all entries following these instructions:

Item 01 - RECORD. This is assigned by the Soil Survey Laboratory.

Item 02 - STATUS. This indicates the kind of data storage. Circle:
--N, if data are in the Soil Survey Laboratory computer files.
--O, if part or all of the data are stored in computer files other than those of the Soil Survey Laboratory
--X, if data storage is not computerized
--F, reserved

Item 03 - PEDON NUMBER. This is a unique sequential number that is entered by the Soil Survey Laboratory. All communications with the Soil Survey Laboratory that concern a pedon must use its reference number.

Item 04 - INITIALS MONTH/YEAR. Enter the initials of the staff member who is responsible for completing the applicable portions of the NRCS-SOI-8 form. Also indicate the month and year of entry; for example, for April 1992, enter "04/92."

Item 05 - LATITUDE. Enter degrees and direction from the equator, and minutes and seconds.

Item 06 - LONGITUDE. Enter degrees and direction from the prime meridian, and minutes and seconds.

Item 07 - CURRENT NAME. Enter the current series name or "SND" (series not designated) for the pedon sampled after any review or any classification using laboratory data. After the series name, if applicable, enter "I" for inclusion if the pedon is not in the name of the map unit listed in item 09.

Item 08 - DATE. Enter the date that the current name was assigned in item 01; for example, for May 1992, enter "05/92."

Item 09 - PUBLICATION SYMBOL. If one has been assigned, enter the publication symbol of the map unit in which the pedon was sampled.

Item 10 - TAXONOMY CODE. Circle the most appropriate code for the pedon ("F" for family classification, "L" for series type location, "R" for the series range, "T" for taxadjunct, "V" for variant, and "S" for slightly outside the range of the series but within the classification of the family.) Use "V" only if the pedon sampled was correlated as a variant. The use of variant has been discontinued and only applies to older correlations. If item 07 is "SND", code "F" must be circled. If "T", "V", or "S" is circled, give a brief explanation in the "NOTES" as to why the pedon is outside the range of the series. The classification of the pedon in the series category should be in accord with the current official soil series description and with the current rules, as of the date in item 08, that are used for identification of taxadjuncts and variants.

Item 11 - SOURCE. Circle the code that identifies the source document for the results of the analyses indexed on this form. If there is more than one source document, the codes should be listed in the following sequence: "I" for SSIR, "M" for published soil survey, "O" for other published source, "T" for thesis, and "U" for unpublished data.

Item 12 - SAMPLED AS. Enter the series name that was assigned to the pedon when it was sampled. If the series name is not known, enter "SND." After the series name, if applicable, enter either "L" for type location, "T" for taxadjunct, "V" for variant, or "P" for proposed series.

Item 13 - FIELD SYMBOL. Enter the field map unit symbol if the publication symbol has not been assigned. Length of entry is limited to five characters.

Item 14 - LABORATORY SAMPLE NUMBERS. Enter the first and last laboratory sample number assigned to the horizons of the pedon by the laboratory that is identified in item 15.

Item 15 - LABORATORY. Enter the Federal Information Processing Standards (FIPS) alphabetic code for the state in which the laboratory that made most of the analyses indexed on this form is located and circle the code that identifies that laboratory. Circle "S" for the former Riverside, Lincoln, or Beltsville NRCS regional soil survey laboratories; "L" for the NRCS Soil Survey Laboratory; "C" for a NRCS state laboratory; "M" for a NRCS soil mechanics laboratory; and "O" for other laboratories. If "O" is circled, then list the name of laboratory in item 22.

Item 16 - SAMPLE. Circle "Y" for yes or "N" for no to indicate whether or not bulk samples are on hand. Circle "U" if this information is unknown.

Item 17 - SOIL SURVEY SAMPLE NUMBER. Enter the Soil Survey Sample Number (SSSN) as it is normally written, for example, S85AA-007-001A. (The letters A-Z are used for satellite pedons). Use the FIPS two-character code for the state and the FIPS three-digit numeric code for the county.

Item 18 - MAJOR LAND RESOURCE AREA (MLRA). Enter the code for the land resource region and major land resource area and, if applicable, the subdivision code of the MLRA. Use the county NATIONAL RESOURCE INVENTORY (NRI) map to obtain the MLRA code.

Item 19 - DATE CLASSIFIED. The person who last classified or amended the classification of the pedon completes this item. Enter the month and year that the pedon was classified using four digits; for example, "12/90." For updating records, such as if the classification of the pedon is changed, enter the current month and year in this item. This item is the date of the most recent review of the classification.

Item 20 - SOIL SURVEY AREA. Enter the soil survey area identification number for the area in which the pedon was sampled.

Item 21 - MOISTURE REGIME. Enter the code for the soil moisture regime as given in Appendix A of the State Soil Survey Database User's Manual.

Item 22 - REFERENCE CITATION. If the data for the pedon are published, enter a reference citation for the source document or thesis indicated in SOURCE (11) using the FIPS alphabetic code for the state and use other abbreviations to restrict entry to 24 characters, including spacing and punctuation. Also circle "P" for published following the citation. The format that uses "SSIR" followed by a space, the number of the volume, a comma, space, a "P," and the page number are mandatory for SSIR's; for example, "SSIR 2, P21." The format exemplified by "SONOMA CO., CA, P178" is preferred for published soil surveys. A suggested format for thesis is exemplified by "DONOVAN, MS-TEX Tech-74." If the source data are unpublished and the letter "O" is circled in item 15, enter the abbreviated name of that laboratory, for example, "BLM, Denver, CO" or "TX A and M, Ag. Exp. Sta," and circle "U" for unpublished following the name.

Item 23 - TAXONOMY CODES. Enter the applicable taxonomic codes for the family classification of the pedon as given in NASIS Metadata 5.0 (http://nasis.nrcs.usda.gov/documents/metadata/5_0/). Always enter a code for frigid, cryic, or pergelic temperature regimes for use in computer searches. For example:

U UD PA PL/04 096 46 __ 18 ___
OR SO GG SGMOD PS MIN PH TEM OTH

Items 24-30 - The family classification of the pedon is generated from the TAXONOMY CODES and printed out here.

Items 39-67 - The analyses counts and subclasses are based on the pedon data in the laboratory files and other laboratory data maintained in state files. If other data are available (including Highway Laboratory test data), enter the actual count of the analyses and subclass, if applicable, or adjust existing index entries to include the additional data. The Soil Survey Laboratory completes this section for all samples analyzed at the Soil Survey Laboratory. The MLRA office is responsible for information for samples analyzed at a laboratory other than the Soil Survey Laboratory.

For more information contact:

Soil Survey Laboratory
National Soil Survey Center

Exhibit 631-3 Research Work Plan Checklist.

1. Statement of Problem
   -concise summary
   -questions that illustrate problem and should be answered by the study
   -operational, such as "need to know in order to" rather than just need to know

2. Justification
   -local importance, such as for county
   -implications for wider application, such as at State and regional levels
   -benefit(s) to the soil survey program

3. Background
   -setting, such as climate, geology, landscapes, or soils.
   -soil series and their classification
   -persons familiar with the problem, such as those in NRCS or at a university.
   -specific background work pertaining to the problem, such as fieldwork, reviews, preliminary data gathering

4. Information Needed
   -geomorphic assistance
   -literature review
   -evaluation of existing data
   -information to be gathered in present study

5. Actions and Assignments
   -projected time table
   -project coordinators such as the person in the state whom the National Soil Survey Center staff should contact
   -Soil Survey Laboratory assistance needed:
      -analyses suggested, such as specific questions to be answered for each soil and or horizon (complete analyses are not necessarily needed for limited, specific problems)
      -persons involved, including when and for what, and any necessary travel, etc.
   -report responsibility
   -report review responsibility
   -distribution and application of data, such as within state or in other states.

6. Illustrations
   -diagrams and illustrations that define study area location, soil-landscape, and stratigraphic relationships.

Exhibit 631-4 Example Research Work Plan.

INVESTIGATION OF THE SOILS IN
THE REGION OF GLACIAL LAKE KASKASKIA
IN MLRAs 113, 114, AND 115

Sam J. Jones
MLRA Project Office
Belleville, IL

The Problem

(a) A significant portion of St. Clair County, and portions of Randolph, Monroe, Washington, Clinton, Bond, Fayette, and Marion Counties (Figure 1) are underlain by glaciofluvial and lacustrine deposits. These deposits can range in age from pre-Illinoian (formerly designated as Kansan or Nebraskan, and now grouped together as middle Pleistocene) to Woodfordian (mid to late Wisconsinan or late Pleistocene) or even to Holocene. The youngest of these deposits related to glacial activity is correlated with the Equality Formation (described by Willman and Frye, 1970). The fluvial deposits in the present flood plain area are correlated with the Cahokia Alluvium.

(b) The younger deposits in Glacial Lake Kaskaskia are part of the Equality Formation. Most of these areas are covered by Peoria Loess, except for the lowermost Woodfordian and possibly the early Holocene terrace level, which appears to have little or no loess cover (Figure 2). Extensive areas of Iva, Weir, Piasa, Herrick, Virden, and other similar soils were mapped on the other terraces along the Kaskaskia River. These soils typically formed in materials considered to be associated with upland positions.

(c) The original field sheets for the St. Clair County soil survey showed mapping units represented by tentative symbols, such as V308 (Alford), V453 (Muren), T16 (Rushville), V47 (Virden), T453B (Muren), and T454A (Iva). "V" was used for variant and "T" for terrace. These symbols were used to suggest differences in stratigraphy that do not traditionally occur in these upland soils. Documentation and correspondence during the survey also supported differences in stratigraphy. These differences were included in the "Formation of the Soils" section of the St. Clair County soil survey (Figure 3) (Wallace, 1978) but not included in the mapping and classification of the soils in the county. One of the main reasons for this exclusion was the emphasis in the 1978 survey on the description and classification of the soils to a depth of only 60 inches.

(d) More recently, the terrace/upland problem has been recognized in adjacent counties. During the recently completed Clinton County soil survey, soils formed in lacustrine deposits were mapped as T46 (Herrick), T47 (Virden), and 474 (Piasa). Soils mapped in mapping units T47 and 474 were eventually classified as a Montgomery taxajunct (a soil developed in lacustrine material), and a new soil series was developed in lieu of terraced-positioned Herrick soil mapped in map unit T46 to recognize the importance of the lacustrine parent material.

(e) Questions have arisen on the impact of these terrace soils and underlying materials on water availability for crops, crop yields, and water quality. The Iva (86 bu/ac), Herrick (89 bu/ac), and Virden (91 bu/ac) upland soils have relatively high corn yields listed in University of Illinois Circular 1156 (Fehrenbacher et al., 1978) compared to the listed yields of the traditional terrace soils, which include Okaw (47 bu/ac) and Hurst (52 bu/ac). Also, the yield on areas on the terrace mapped as Piasa is much higher than that listed for the Piasa (52 bu/ac) that is traditionally mapped as an upland soil. These discrepancies have been brought to light in recent tax appeals to the State Board of Review. Differences in observed yields suggest differences in soils and available moisture for crop growth. These differences also suggest that the clayey substratum of the terrace soils influence the available water and the movement of the water through the soil.

(f) The problem involves not only accurately mapping and classifying the surface soils but also accurately identifying and mapping the underlying materials, which influence the genesis, classification, and management of these soils. The objective of this study is to accurately identify soils, parent materials, and stratigraphy in the Glacial Lake Kaskaskia area. The hypothesis is that soils in the Glacial Lake Kaskaskia area differ from the upland soils, and that this difference is reflected in stratigraphy, physical and chemical soil properties, water status, and crop yields. Studying these soils in detail will provide more accurate interpretations for agricultural and urban uses in the Glacial Lake area and the adjoining upland areas.

Justification

The Kaskaskia River glaciofluvial and lacustrine deposits occur in eight counties. The drainage basin of the Kaskaskia River covers 3,712,640 acres. The importance of the surficial and subsurficial materials in the Kaskaskia River Basin to agriculture and to the ground-water quality of the area is evident. Rapid urban growth is occurring in St. Clair, Randolph, and Monroe Counties, and therefore, more urban and agricultural demands are being made on water that is supplied by the Kaskaskia River Basin. St. Clair County is currently being updated as part of the Major Land Resource Area Soil Survey Update program in Illinois. Not only will the update in St. Clair County benefit from this study, all updates of the other counties within MLRAs 113, 114, and 115 that have glaciofluvial and lacustrine deposits will also benefit. The information gained in this study will improve the credibility of the soil survey by supplying the survey users with more accurate and precise soil maps and interpretations. We will also be gathering soils and geology information at greater depths.

Background

(a) Most of the soils in the study area are the types that occur on uplands. The uplands consist mainly of the Illinoian glacial till plain or glacial outwash plain that is covered by loess. The total thickness of the Peoria Loess and Roxana Silt ranges from 100 feet in the western part of the area to 4 or 5 feet in the eastern part. Soils on the terraces formed in loess less than 60 inches thick overlying clayey material or in the clayey material. There are also extensive areas of alluvial lands and bottomlands that drain to the Kaskaskia River, which, drains into the Mississippi River.

(b) The focus of this study is to determine the boundary between the upland areas, represented primarily by soils formed in loess over glacial till, and the areas represented primarily by soils formed in glaciofluvial and lacustrine deposits. The difficulty in determining this boundary was well documented by the former soil survey leader of the 1978 St. Clair County soil survey and his primary survey members. Historical correspondence between the soil survey party, the Illinois State Geological Survey, and the MLRA staff shows the difficulty and importance of making this determination. Unfortunately, the separations made by the soil survey party were dropped during correlation and final publication. This action was due to the emphasis on studying the soil to a depth of only 60 inches and to the emphasis on the taxonomic placement of pedons. The MLRA update surveys will include more detailed descriptions at greater depths in order to meet the demands of modern agriculture and urbanization.

Information Needed

A soil-geomorphic/soil-stratigraphy study would be appropriate to determine the characteristics and extent of the glacial lake and to examine the relationship of these deposits to the distribution of soils across the landscape. From this study we could expand our knowledge of geomorphology and pedogenesis and gain a greater understanding of the geologic history of the Kaskaskia River Basin.

Action and Assignments

(a) The MLRA update office requests the assistance of the staff at the National Soil Survey Center in Lincoln, NE. The Illinois Soil Survey Laboratory liaison is familiar with the area. He has expressed interest in working on this problem and would be of great assistance in determining the soil-geomorphic/soil-stratigraphy relationships.

(b) The coordinators for the study will be the MLRA project coordinator, the area soil scientist at Carbondale, IL, and the Illinois State Soil Scientist. I will be the contact person. Other participants will be personnel from the Illinois State University and soil scientists in MLRAs 113, 114, and 115.

(c) Deep cores taken with a hydraulic probe and pits will be used to describe soils and sediments and to collect samples for appropriate chemical, physical, and mineralogical analyses.

(d) The study will be carried out in stages. The first stage will begin in November in St. Clair County. Transects will be made across three major valleys in St. Clair County: the Kaskaskia, Silver Creek, and Richland Creek valleys. Deep cores (at depths > 20 feet) will be taken in transects perpendicular to each valley. A minimum of four cores will be taken in each transect; and each transect will begin in the upland and continue down an interfluve to the predicted terrace level, across the river channel to the terrace level on the other side, and again up an interfluve to the upland. Transect and core locations will be determined from topographic data and existing core data. We will determine the geomorphic and stratigraphic relationships with emphasis on identifying the presence or absence of the Sangamon Geosol. The Sangamon Geosol is a key marker in identifying upland positions.

(e) Tracing the Sangamon towards the streams will reveal where the Sangamon has been eroded out of the valley. At the erosional boundary we expect the surface to be covered by Wisconsinan deposits, and in places it may be lacustrine (slack water deposits). Therefore, we need to examine the water regime characteristics at this geologic boundary to determine its influence on the distribution of modern soils (especially "problem" soils, such as Natraqualfs).

(f) In places the development of the present soils in loess over the Pearl Formation with a Sangamon Geosol is different than that of the soils in loess over the Sangamon Geosol in till. The soils in the Pearl Formation are commonly developed to a greater depth and in places are better agronomic soils. This relationship may, in part, explain the higher yields of the Piasa mapped on the terrace as compared to the yields for the Piasa mapped on the upland.

(g) The results from the first stage of this study will be used to guide the investigations in other counties that contain Kaskaskia glaciofluvial and lacustrine sediments. After determining the soil geomorphic and soil stratigraphic relationships in St. Clair County, the next portion of the study will take place downstream in Monroe and Randolph Counties and upstream in Washington, Clinton, Fayette, Bond, and Marion Counties. We hope to begin this portion of the study in the spring of 1992. The goal is to map the areal distribution of glaciofluvial and lacustrine sediments in the eight-county study area and eventually throughout Southern Illinois and to determine the influence of these sediments on the genesis, morphology, classification, and management of the modern soils. The results of this study will be published and distributed to states that have extensive glaciofluvial and lacustrine sediments.

Summary of Plan of Action

(a) The MLRA project coordinator in conjunction with the Illinois State Geological Survey (ISGS) will perform a literature review. (Completed 11/91).

(b) The details of the experimental design and laboratory needs will be determined by the MLRA project coordinator, the area soil scientist, the liaison for the National Soil Survey Center, and the Illinois State Geological Survey. At this time we will determine what water table, hydraulic conductivity, and yield data are needed for the study. (Completed 11/91).

(c) The fieldwork for the study will begin with 1 or 2 weeks of fieldwork in 11/91 and with cooperation between the Illinois NRCS, ISGS, and the National Soil Survey Center.

(d) Information gathered from the first three steps will guide the direction of the next portion of the fieldwork that is to be carried out in 3/92.

(e) It is envisioned that the study will take 3 to 4 years to ensure sufficient collection of soils, yield, and water table data.

References

Fehrenbacher, J.B., R.A. Pope, I.J. Jansen, J.D. Alexander, and B.W. Ray. 1978. Soil productivity in Illinois. University of Illinois at Urbana-Champaign, College of Agriculture, Cooperative Extension Service, Circular 1156.

Wallace, D.L. 1978. Soil Survey of St. Clair County, Illinois. U.S. Government Printing Office, Washington, D.C.

Willmam, H.B., and J.C. Frye. 1970. Pleistocene stratigraphy of Illinois. Illinois State Geological Survey Bulletin, 94, 204 pp.

Exhibit 631-5 Example of a Soil Characterization Work Plan.

SOIL CHARACTERIZATION WORK PLAN

Identification:
State: *Kansas* Date: *September 15, 1990*
Investigation project name: *Brown County Study*
County (Counties): *Brown*
MLRA:
Plan prepared by: Name *Jim Jones*
In-state contact(s): Name *Jim Jones*
Actively cooperating agencies: *Kansas Agricultural Exp. Sta.*

Give the area or region of sampling, if appropriate, or the name(s) of soil survey area(s) if they are different from the county (counties) identified above.

Reason for Investigations Project:
Underscore the number for the primary reason(s) for the project.
1. Needs of current project soil survey
2. Survey update or modernization
3. Interpretations problem
4. Regional recorrelation or redefinition of series.
5. Study of genetic factors, processes, relationships
6. Support of other activity (such as an agronomic study)
7. Other (specify)

Intended Use of Project Information:
Underscore the number for the primary uses.
1. Characterize series or phase
2. Document experimental or study site(s)
3. Determine classification
4. Support correlation
5. Test Soil Taxonomy
6. Study soil relationships
7. Included in the published soil survey report
8. Other (specify)

For items 4, 5, 6, or 7, list questions to be answered.

Assistance Requested:
Which year(s): *1990*
Lab analyses from: SSL Only *x* SSL and:
If data needed in less than one year, when needed?

Consultation before sampling?	yes	*no*	
Field study before sampling?	yes	*no*	
Reference samples to guide site selection?	*yes*	no	
Help with sampling?		*yes*	no
Sampling equipment from SSL?	*yes*	no	

Number of pedons: *5-7*
Approximate number of samples: *50-55*
Ship to: *Name*
Natural Resources Conservation Service
Address
Town, State Zip

Proposed date for sampling: *May 7-11, 1990*
Alternative date(s):

Status of Site Selection:

1.	Sample sites have been identified				
	a. specific pedons?		*yes*	no	
	b. specific area (within 500 feet)?	yes	no		
	c. general area (within a mile or two)?	yes	no		
2.	Transect information available	yes	*no*		
3.	If 1a is no, when will pedons be selected?				

Persons or Agencies Responsible:
Site selection: *Project office*
Excavation of pits: *Local NRCS*
Tools, equipment, materials: *SSL*
Descriptions and classification: *State Personnel*
Sample shipment: *Kansas State Office*
Analyses, other than SSL: *none*
Other:

Other Pertinent Information:
(may be supplied by attachments, such as official series descriptions, if applicable)

Pedon 5: *Amego soil does not have free carbonates in the solum. The soils mapped in Brown County do.*

Complete Table 1 for all projects; list alternatives if purpose is to check classification. Complete other tables insofar as information is readily available.

Table 1 Classification of Pedons to be Sampled.

Pedon Number	Classification to Family	Series (and phase, if important)
1	*Typic Hapludolls* *fine-silty, mixed, superactive, mesic*	*Marshall**
2	*Aquertic Argiudolls,* *fine, smectitic, mesic*	*Mayberry*
3	*Aquertic Argiudolls* *fine, smectitic, mesic*	*Chase*
4	*Typic Hapludolls,* *loamy, mixed, superactive, mesic, shallow*	*Vinland*
5	*Typic Argiudolls* *fine, mixed,superactive, mesic*	*Wamego**

* *Pedons to be sampled may not be representative of the named series but may become new series.*

Table 2 Extent of Series or Other Class Represented.

Pedon Number	Estimated Extent, acres This Survey Area	State	Total
1		*173,000*	*1,600,000*
2		*2,000*	*111,000*
3		*97,000*	*97,000*
4		*132,000*	*132,000*
5		*39,000*	*39,000*

Table 3 Genetic Factors of Soils.
(Attach block diagrams, geologic cross section, etc., if available)

Pedon Number	Parent Material	Landscape Position	Drainage Class	Vegetation (Site)	Other
1	*Loess*	*Upland ridge*	*W*	*Corn*	
2	*Till*	*Convex summit*	*MW*	*Wheat*	
3	*Alluvium*	*Low terrace*	*SP*	*Soybeans*	
4	*Shale*	*Steep upland*	*E*	*Pasture*	
5	*Shale,ss*	*Narrow ridge*	*W*	*Native grass*	

Table 4 Useful Data Available for These or Similar Soils.
(Use lines as needed for each pedon to be sampled)

		Similar Pedons Previously Analyzed			
Pedon Number	Year & State	County	NRCS Lab or other	Same Series Family	Other Similar
3	*KS1983*	*Morris*	*SSL*	*Series*	
5	*KS1987*	*Wabaunsee*	*SSL*	*Series*	

Part 638 - SOIL DATA SYSTEMS

CONTENTS

Part 638 - SOIL DATA SYSTEMS

638.00 Definition and Purpose.

(a) Soil data systems aid the collection, storage, manipulation, and dissemination of soil information. Soil data systems consist of multiple automated soil applications or modules that stand alone or interact with each other to provide information.

(b) The National Cooperative Soil Survey (NCSS) collects, manages, interprets, and disseminates soil survey information using a dynamic soil information system from which many different products can be made.

638.01 Policy and Responsibilities.

(a) Policy. Soil survey information is maintained in the National Soil Information System. Users of automated soil applications who are members of NCSS are provided support and training on the use and management of all automated soil applications.

(b) Responsibilities.

(1) The state soil scientist is responsible for:
-- distributing soil information to users;
-- assisting users of the information system;
-- supplementing the system by developing soil interpretive group assignments and forwarding to the MLRA office for inclusion;
-- maintaining current soil information in the field office computer systems (FOCS); and
-- coordinating instate training on the use of automated soil applications.

(2) The MLRA office is responsible for:
-- for the technical quality and completeness of the information in the National Soil Information System;
-- providing user training for automated soil applications;
-- providing continuing user support for all automated soil applications;
-- managing the system and maintaining the soil information in the system;
-- providing a liaison to the National Soil Survey Center and Technical Information System Division staffs;
-- evaluating proposals for new applications and for enhancements to existing applications; and
-- recommending development priorities to the National Soil Survey Center.

(3) The National Soil Survey Center is responsible for:
-- developing and implementing policy and guidelines for data administration and management, including quality control procedures;
-- providing application analysis to support system development;
-- managing the NCSS soil data dictionary as a subset of the NRCS corporate data dictionary;
-- providing training to MLRA offices and assisting MLRA office staffs in providing training to project offices;
-- assisting in system building tasks, such as developing documentation, testing, and data conversion; and
-- coordinating with the Information Technology Center to develop software for soil data systems.

(4) The NRCS develops and maintains the National Soil Information System, the official series description (OSD), the soil classification (SC), the national soil survey database, and the national soil characterization database.

638.02 National Soil Information System (NASIS)

Components of NASIS are released in increments. NASIS will eventually encompass four major data categories--**map unit records** including legends, map units, and the physical, chemical, and morphological properties and interpretations for map unit components; **geographic area records** including symbols, names, and acreages; **point characteristics** including soil profile descriptions, laboratory characterization data, field measurements, transect observations, and other site specific information; and **standards, criteria, and guidelines** including taxonomic class limits, series ranges in characteristics, interpretation criteria, and other data and documents used to establish concepts, assist aggregation, and communicate policy. These databases are intended to be available on a national basis, as well as in state or local subsets. Part 639 provides more specific information on NASIS.

638.03 Map Unit Record File.

(a) The map unit record database of NASIS was initially populated by converting soil survey area specific information and interpretations in the State Soil Survey Database map unit interpretation records into a new format. Procedures are developed to generate interpretations within the NASIS software in future releases. This information will then be used to develop manuscript tables and for downloading to other application systems such as geographic information systems and Field Office Computing System (FOCS).

(b) Data of the map unit records for correlated soil surveys are certified by the MLRA office to be correct, current, and complete. Data within the map unit record are updated as needed after correlation and after the soil survey is published so that the data remain current and correct.

(c) When revising data refer to part 610 concerning the official copy of the soil survey and types of revisions and required procedures.

638.04 Official Series Descriptions File (OSD) and the Soil Classification File.

(a) Official series descriptions are accessed in the soil survey database in every MLRA office. Official series descriptions are updated and processed with utilities that are part of the soil survey database. As MLRA offices add, delete, or revise series for which they have responsibility, they transmit these series to the Iowa State University Statistical Laboratory at Ames, Iowa, where the series from all states are stored in the official series description file. The soil classification file is also maintained at Ames; and, as series are added to the official series description file, the soil classification file needs to be updated accordingly. The classification of a soil series listed on the official series description and that listed in the soil classification file are kept in agreement by the MLRA office.

(b) The State Soil Survey Database User's Manual provides specific information and instructions on management of the official series description files until these files are incorporated into the National Soil Information System.

638.05 Soil Survey Schedule Database.

The Soil Survey Schedule is a database that is stored in the State Soil Survey Database. It provides a method of tracking the progress of soil surveys at the State level. The database has the ability to provide this information to the National Soil Survey Center, where surveys are tracked at the National level. The State Soil Survey Database User's Manual and Part 608 of this handbook provide additional information on the Soil Survey Schedule.

638.06 The Pedon Description Program (PDP).

(a) The Pedon Description Program is a database of information gathered by describing pedons in the field. The database can be used to sort, select, aggregate, and compare data; it is also programmed to produce a written copy of the pedon description. The Pedon Description Program User's Manual provides detailed information on the Pedon Description Program.

(b) The project office is responsible for:
- -- using the Pedon Description Program within the soil survey area,
- -- adequately describing a representative pedon for each component of each map unit in the soil survey area,
- -- obtaining pedon descriptions for each pedon that is submitted for complete and partial laboratory analysis, and
- -- entering all pedon descriptions and related information into the Pedon Description Program.

(c) The MLRA office is responsible for:
- -- ensuring the integrity and consistency of the data in the Pedon Description Program within the MLRA, and

-- assuring the quality of the data entered in the Pedon Description Program.

638.07 Guidelines For Changing, Adding, or Deleting Soil Property Data Elements.

(a) The NRCS, Soil Survey Division, maintains a soil data dictionary, which contains the national list of approved soil attributes and the standards for naming, defining, and implementing attributes in soil databases.

(b) The National Soil Survey Center is responsible for maintaining the soil data dictionary and for integrating soil data within soil information systems as well as within other NRCS information systems.

(c) Changes, additions, or deletions to soil data dictionary are proposed by any participant in the National Cooperative Soil Survey (NCSS). Those suggestions are transmitted to the National Soil Survey Center.

(d) Changes, additions, or deletions to the soil data dictionary are defined as:
-- adding or removing attributes from the approved list of soil attributes;
-- changing the definition of an existing attribute, including adding to, removing from, or redefining abbreviations or codes used to describe soil properties; and
-- adding to, removing from, changing, or redefining the method(s) used to obtain data for an attribute or changing the method(s) used for the derivation of data values for the attribute.

(e) The following steps are followed in proposing new or revised soil property data elements.

(1) Formulate the need for new or revised soil attributes.

(2) Record the necessary descriptive information for the data element using Exhibit 638-3.

(3) Forward data element proposals for changes, additions, or deletions to the National Soil Survey Center for coordination of review and update of the soil data dictionary.

638.08 Certification and Distribution of Soil Data.

Data from NASIS are distributed in two ways.

(a) Soil database information in the field office computer system (FOCS).
The soil data within the field office computer system is provided from the National Soil Information System map unit record. The state soil scientist is responsible for providing the current soil database to the field office computer system.

The state soil scientist certifies data downloaded to the field office computer system. An example certification letter for the field office computer system is provided in Exhibit 638-1. Soil data is not to be downloaded to the field office computer system until it has been edited. Soil data elements downloaded to the field office computer system are edited and certified for each field office computer system application, such as the Revised Universal Soil Loss Equation (RUSLE).

(b) Soil database information distributed to cooperators and the public.
(1) The state soil scientist will state the date and source of the data when distributing data to the public. An example letter for data distributed to the public is provided in Exhibit 638-2.

(2) Data are distributed from the National Soil Information System.

(3) The state soil scientist maintains a file of users who have received digital map unit record data sets. Minimum documentation in the file includes requester, date, and brief description of data provided.

(4) User documentation or a user guide is provided with each data set that is distributed. As a minimum, the following information is included:
-- the definition of data elements (data dictionary),
-- a description of the data format,
-- a disclaimer on the use of the data, and
-- a request that NRCS be acknowledged as the source of the data.

Exhibit 638-1 Example of Certification Information Given by the State Soil Scientist to the District Conservationist.

Subject: SOI - Edit Certification of Soil Data for the Field Office Computer System Application Modules.

To: Jack Smith
District Conservationist
Paradise Field Office

The soil data elements for the data set provided in this FOCS/soil database download have been edited and coordinated for use in the following FOCS applications: ______________________________.

The soil data elements have not been edited for the following FOCS applications: ______________________________, and reports that are generated from these applications must not be distributed to the public.

Jane Smith
State Soil Scientist

Exhibit 638-2 Example of Statement to Include in Letter to Public When Distributing Map Unit Record (MUR) Data.

Map unit record (MUR) data from the ________ state subset of the national soil information system are the source of digital attribute soil data for soil maps in the Soil Survey(s) of _______________ County(ies). Data in these files are periodically updated. Files are dated. Users are responsible for obtaining the latest version of the data. For more information contact _____________________________.

Exhibit 638-3 Proposed Amendment to Soil Data Dictionary.

Attribute Name (proposed or modified):

____

Data Type: (check one)

☐ text <256 characters: length __________

☐ text >256 characters

☐ number lowest value ______ highest value________ unit of measure_________

integer? ________________ float?__________ decimal places__________

☐ choice list ________________ choices (attach) choice definition (attach)

Definition of attribute:

____

____

Purpose (Why it is necessary, how it is used)

____

____

____

Relationship to other data, validation, calculations

____

____

Part 639 - NATIONAL SOIL INFORMATION SYSTEM (NASIS)

CONTENTS

639.00 Definition and Purpose.

The National Soil Information System integrates soil survey information, operations, and management. It divides soil survey data into four major categories: 1) map unit records, 2) geographic area records, 3) point characteristics, and 4) standards, criteria, and guidelines. The system also includes ancillary tools, functions, and records to assure the security, integrity, and utility of the soil survey data.

639.01 Policy and Responsibility.

The National Soil Information System (NASIS) is the official depository for the latest soil survey information. Official changes are maintained by the MLRA office. Distribution of information is through this official file. A file of all nationwide data is stored at Iowa State University Statistical Laboratory.

639.02 Map Unit Records.

Map unit records include soil survey area legends, map units, and the physical, chemical, and morphological properties and interpretations for map units and their components. Map unit records are subdivided into three parts: the **legend object**, the **data mapunit object**, and the **map unit record text**.

The National Soil Information System (NASIS) introduces some new terminology to soil survey. The phrases "legend mapunit" and "data mapunit" are invented terms for concepts to describe data relationships. The term "legend mapunit" has now been shortened to "legend". An object is either a record or a collection of records. Within NASIS the **legend object** contains the map unit symbol, map unit name, kind of map unit (consociation, complex, etc.), and correlation notes. The identification used for the **legend** is the map unit symbol that is common to the soil survey map and the soil survey legend. The **data mapunit object** includes the map unit composition, physical, chemical, morphological, and interpretation records for a map unit and its components. The identification used for the **data mapunit** is a system assigned unique number that is used only in the database to identify a set of map unit attributes. The **map unit record text** contains additional notes, nontechnical descriptions, and other documentation related to either the **legend** or the **data mapunit** and is a part of the records of either the **legend object** or the **data mapunit object**.

(a) The legend object.

The purpose of the **legend object** is to maintain map unit symbol, name, and correlation records for each map unit in the legend and provide a link to both areas and **data mapunits**. It provides a continuous record of legend development and correlation decisions made throughout the survey. These records are used to create the map unit identification legend, conversion legends, and correlation status reports for the survey area. The **legend object** is created at the beginning of the survey and retained as part of the historical records.

The **legend object** includes several tables in the National Soil Information System. Responsibility and ownership of a specific legend is indicated by the database and group columns in the legend table. Authority to edit the **legend object** is limited to users who are members of the group that is responsible for the legend. The user who creates or changes any part of the **legend object** is recorded in the legend table, as well as the date and time of that change. Generally, the legend in an on-going survey is the responsibility of the soil survey project office. Responsibility is transferred to the MLRA office at completion of the survey.

The tables in the **legend object** are defined below. Descriptions for **legend object** data elements are available in the National Soil Information System on-line help. Some data elements are restricted to specific entries, others allow any appropriate entry.

(1) Legend table: legend description.

(i) Definition. The **legend description** is the name of a short text field used to describe a particular soil survey area legend. Survey areas typically have two legends, a detailed soil map legend and a general soil map legend. Some survey areas have a field legend and a final publication legend.

(ii) Entry. Enter an appropriate description for the legend such as "detailed soil map legend". Operational status for the survey area legend, whether published or out-of-date, is recorded in the legend table as survey status.

(2) Mapunit table: mapunit symbol.

(i) Definition. The **mapunit symbol** is the name of the field used for a soil map unit symbol. The **mapunit symbol** uniquely identifies the soil map unit in the soil survey. It is alphabetic (AcA), numeric (54), or alphanumeric (129B). Once a map unit symbol has been used in the survey area legend, it is permanently recorded in the **mapunit table** and on original soil maps so that a conversion legend may be produced and original field work accurately reproduced. A soil map unit symbol in the **mapunit symbol** field of the **legend object** is linked to the **data mapunit object** through the **correlation table**. Consequently, different soil map unit symbols in either the same or different legends can be linked to the same data within the **data mapunit object** providing the capability to create conversion legends, join map units between survey areas, and coordinate MLRA or statewide legends.

(3) Mapunit table: mapunit status.

(i) Definition. Mapunit status is the name of a field for specific terms that identify the current status of the map unit.

(ii) Classes and Definitions.

Provisional - A provisional soil map unit is a map unit used in the soil survey that has not been officially approved for use. Typically, a provisional map unit is either approved for use at the next progress field review and changed to approved status, or is disapproved, changed to additional status, correlated with another map unit, and maintained in the map unit table.

Approved - An approved soil map unit is a map unit on the current, signed review report for the survey area. Typically, a map unit is approved at a progress field review after sufficient field investigation indicates a need for the map unit. In some cases, an approved map unit will not be retained on the active legend, but changed to additional status, correlated with another map unit, and maintained in the map unit table.

Correlated - A correlated soil map unit is a map unit on the signed final correlation document.

Additional - An additional soil map unit is a map unit that has been used in the soil survey area, but that has been combined with another unit in the survey.

(iii) Entry. Enter the appropriate status class for each map unit.

(4) Correlation table: representative DMU.

(i) Definition. A representative DMU indicates whether or not data in the particular **data mapunit** (DMU) is representative for a particular map unit. Map unit symbols may be linked to more than one **data mapunit** in the correlation table, but only one of the **data mapunits** is representative for the map unit.

(ii) Classes and Definitions.

Yes - Indicates the representative **data mapunit.**

No - Indicates non-representative links to other **data mapunits** which generally represent correlation of additional symbols.

(iii) Entry. Enter the appropriate class term.

(5) Correlation table: mapunit constituent acres.

(i) Definition. Mapunit constituent acres is the portion of a **data mapunit** that is linked to a map unit as a part or as a whole of that map unit. Acres recorded for non-representative **data mapunits** are acres mapped for the additional map unit symbol and **data mapunit** intersection. Acres recorded for the representative **data mapunit** are acres for the current map unit symbol. The sum of constituent acres is the total acreage of the correlated map unit.

(6) Mapunit history table: mapunit history date.

(i) Definition. Mapunit history date is the date of a name or status change for a particular map unit.

(7) Mapunit history table: mapunit name historical.

(i) Definition. Mapunit name historical is a name that was previously used for the soil map unit. This entry provides documentation of each name change for the map unit.

(8) Mapunit history table: mapunit status historical.

(i) Definition. Mapunit status historical is a map unit status term used to describe a previous status for the soil map unit from the time it was added to the soil survey legend. This entry provides documentation of each status change for the map unit. The classes used are the same as those used for **mapunit status**.

(9) Legend area overlap table: area overlap acres.

(i) Definition. Area overlap acres is the portion of the geographic overlap of the soil survey area and another geographic area. Typically, an area overlap is recorded for each county, MLRA, Climate factor area, and Rainfall factor area in the survey area even if acreages are not entered.

(10) Mapunit area overlap table: area overlap acres.

(i) Definition. For this table, **area overlap acres** is the portion of the map unit in a particular geographic area. Typically, the occurrence of a map unit in a geographic area is recorded even if acreages are not entered. Acreages are entered for map units in each county in the survey area.

(b) The data mapunit object.

The **data mapunit object** is a record or a collection of records concerning composition, physical, chemical, morphological, and interpretation properties and performance for a map unit and each of its components. A **data mapunit object** is a set of data records and as such is not related to any geographic area or map unit delineation unless linked to a delineated area in a soil survey area legend. These records are used to document map unit characteristics and create reports of soil properties and interpretations. **Data mapunit objects** are created as needed and retained as part of the historical records.

The **data mapunit object** includes several tables in the National Soil Information System. Ownership of a specific **data mapunit object** is indicated by the NASIS site and group columns in the **data mapunit table**. Authority to edit the **data mapunit object** is limited to users who are members of the group that is responsible for the **data mapunit**. The user who creates or changes any part of the **data mapunit object** is recorded in the **data mapunit table**, as well as the date and time of that change. Generally, responsibility for **data mapunits** that were created by users at the soil survey project office is transferred to the MLRA office at the completion of the soil survey.

Descriptions for **data mapunit object** data elements are available in the National Soil Information System on-line help. Some data elements are restricted to specific entries, others allow any appropriate entry.

(1) Data mapunit table: data mapunit description.

(i) Definition. Data mapunit description is a short text field used to identify a **data mapunit**. A connotative alphabetic or numeric text such as "Tunbridge complex, steep", "NE611, 27B", or "609005" is used. A **data mapunit description** is not required but is useful to identify the intended meaning of the **data mapunit**. **Data mapunits** may be linked to several map units in different soil survey area legends. Consequently, the **data mapunit description** does not uniquely identify the **data mapunit**. Linkages through the correlation table accurately identify the map unit names and symbols associated with the **data mapunit**.

(2) Data mapunit table: data mapunit ID.

(ii) Definition. Data mapunit ID is a unique number to identify the set of records within the **data mapunit object**. The number is non-connotative and used for linking data with geographic areas.

(c) Map Unit Record Text.

The purpose of **map unit record text** is to maintain additional notes, nontechnical descriptions, and other documentation related to horizons, components, **data mapunits**, map units, correlation decisions, and legends. This text is used to document decisions and create reports.

Map unit record text is part of either a **legend object** or **data mapunit object**. Ownership and authority is determined by the object to which it is attached.

Descriptions of text data elements are available in the National Soil Information System on-line help. Some data elements are restricted to specific terms, others allow any appropriate entry. A text entry is identified by its kind, category, and subcategory. The table data elements are described below:

(1) Any of the text tables: text kind.

(i) Definition. Text kind is a specific term that describes the kind of text. It is the highest division of text classification.

(ii) Classes and Definitions.

Correlation notes - Correlation notes is a class name for text entries related to correlation decisions. Typically correlation notes are used in the legend text table or the map unit history text table.

Nontechnical description - Nontechnical description is a class name for text entries related to non technical descriptions. Typically nontechnical descriptions are used in the map unit text table.

S5 description - S5 description is a class name for text related to components of **data mapunits**, specifically accommodating conversion from previous systems. Typically S5 descriptions are used in the component text table.

Miscellaneous notes - Miscellaneous notes is a class name for text not in any other specific kind. Miscellaneous notes are used in any text table.

(iii) Entry. Enter the appropriate class name.

(2) Any of the text tables: text category.

(i) Definition. Text category is any appropriate term necessary to subdivide the kind of text. Typically used with non technical descriptions in the map unit text table to identify the category of non technical description. Examples are "SOI" or "soil" for the soil paragraph, and "AGR" or "crop" for the agricultural cropland paragraph.

(3) Any of the text tables: text subcategory.

(i) Definition. Text subcategory is Any appropriate term necessary to subdivide the kind and category of text.

(4) Any of the text tables: text.

(i) Definition. Text is the actual narrative portion of a text entry. The system displays the expression "Text..." to indicate that text is contained in a separate text edit window that is activated from this column. Text volume is nearly unlimited.

639.03 Geographic Area Records.

Geographic area records include symbols, names, and acreages for soil survey areas as well as other political and physiographic areas. Geographic area records are maintained in the **area type object**.

(a) The area type object.

The purpose of the **area type object** is to maintain soil survey, political, and physiographic area records. The **area type object** provides a complete list of approved soil survey areas and standard acreages for official soil survey areas, states, counties, and Major Land Resource Areas. These records are used in soil survey operations management. An **area type object** is created as necessary and retained as part of the historical records.

The **area type object** includes the area type, area, and area text tables in the National Soil Information System. Responsibility for a specific **area type object** is indicated by the database and group columns in the **area type table**. Authority to edit an **area type object** is limited to users who are members of the group that is responsible. The user who creates or changes any part of the **area type object** is recorded in the area type table, as well as the date and time of that change. Official **area type objects** are the responsibility of the National Soil Survey Center.

Descriptions for **area type object** data elements are available in the National Soil Information System on-line help. Some data elements are restricted to specific entries, others allow any appropriate entry. Data elements for the **area type object** tables are described below.

(1) Area type table: area type name.
(i) Definition. Area type name is the name of the particular type of area. Several types of areas are recorded in addition to soil survey areas. Typical area types are State, County, Climate factor areas, and MLRA Soil Survey Areas.

(2) Area table: area symbol.
(i) Definition. Area symbol is a symbol, unique within a particular area type, that is used to identify the area (e.g. Lancaster County, NE is NE109). Typically, symbols for political areas such as states and counties are Federal Information Processing Standards (FIPS) codes. A survey area and a county may have the same area symbol because each is recorded under a different area type.

(3) Area table: area name.
(i) Definition. Area name is the name given to the specific area. Although a soil survey area may be named for a county, the soil survey area name is recorded under the soil survey area type and the county name is recorded under the county area type, even if the names are the same.

(4) Area table: area acres.
(i) Definition. Area acres is the total acreage of all land and water areas in a specified geographic area. For example, the total acreage of a multi-county soil survey area is recorded in this table, as well as the total acreage for each of the counties. Parts of the soil survey area that occur in each county are recorded in the legend area overlap table. Acreages are not recorded for some area types.

639.04 Point Characteristics

Point characteristics include soil profile descriptions, laboratory characterization data, field measurements, transect observations, and other soil survey data collected at individual sites. Some of these data are currently in PEDON or the Soil Survey Laboratory soil characterization database. Capabilities to coordinate these data in NASIS are under development.

639.05 Standards, Criteria, and Guidelines

Standards, criteria, and guidelines include taxonomic class limits, series ranges in characteristics, interpretation criteria, and other data and documents used to establish concepts, assist aggregation, and communicate policy in soil survey. Some standards, criteria, and guidelines, such as interpretation criteria, are managed as data in NASIS. Other standards, criteria, and guidelines, such as the National Soil Survey Handbook and Soil Survey Manual are managed as printed or as on-line documents.

(a) The interpretation criteria object.
The purpose of the interpretation criteria object is to maintain a list of soil properties, class limits, ranking terms, and restriction terms for each soil survey interpretation. Records in the interpretation criteria object are used to create interpretations or predictions of behavior from the soil physical, chemical, and morphological properties of individual components of map units. Interpretive results are stored and maintained independently from the interpretation criteria object. Interpretation criteria objects include official criteria as well as regionally or locally developed criteria. They are created as needed and retained as part of the historical records.

The interpretation criteria object includes several tables in the National Soil Information System. Facilities to create and maintain interpretation criteria in these tables are under development.

639.06 Ancillary Tools, Functions, and Records.

NASIS maintains additional records and provides editing tools and functions to assure the security, integrity, and utility of the soil survey data.

(a) The NASIS site object.
The purpose of the **NASIS site object** is to maintain security and communication of soil survey data objects and ancillary objects in NASIS. It provides a complete list of networked NASIS sites and authorized users. Each NASIS site has an entry in the **NASIS site object** and that entry is maintained for as long as that NASIS site exists.

The **NASIS site object** includes the NASIS site, group, user, and group member tables.

The **NASIS site table** lists all NASIS sites and users. This table enables the National Soil Information System to share data from site to site. NASIS site records accompany requested data. The fields in this table identify the NASIS site and who to contact if you have any questions about that data.

The **group table** records the groups established at your site as well as all groups associated with any data you have that belongs to another site.

Descriptions for data elements in the **NASIS site object** are available in National Soil Information System on-line documentation.

The **group member table** associates users with groups, not only for the database but also for groups and users associated with any data that belongs to another site. A user can be removed from a group at any time. Group member table data elements are automatically populated by the system.

The **user table** records the National Soil Information System users that have been established at your site as well as all users associated with any data you have that belongs to another site. A person may have a UNIX login ID, but they cannot use the National Soil Information System unless a National Soil Information System user name is associated with their UNIX login ID in this table.

Authority to edit a **NASIS site object** is limited to a user who has NASIS manager privileges for that object.

(1) NASIS site table: database iid (on screen label: Rec ID).

(i) Definition. Database iid is the identification number of the NASIS site that created a particular entity. This is a required integer field that uniquely identifies the local NASIS site. This number must be obtained from the soil hotline staff BEFORE the National Soil Information System site is installed.

(ii) Entry. The entry must be a number that is not already assigned. The numbers 0 through 100 are reserved for use by the National Soil Information System development staff.

(2) NASIS site table: database name (on screen label: NASIS site name).

(i) Definition. Database name is the name of a particular National Soil Information System site. The **database name** has a required 30 character field that records the name that identifies the local site. This name must be obtained from the soil hotline staff BEFORE the National Soil Information System site is installed. This is the source of the NASIS site name that is displayed in the National Soil Information System edit windows.

(ii) Entry. Enter the desired name in the form of location || office type.
Example: MD_State_Office

(3) NASIS site table: database description (on screen label: Description).

(i) Definition. Database description is a narrative text entry that contains information about a particular National Soil Information System site. The **database description** has an optional 60 character field that describes the site to other locations.

(ii) Entry. Enter the desired narrative description.

(4) NASIS site table: database state (on screen label: State).

(i) Definition. Database state is the name of the state in which a particular National Soil Information System site resides. It is expressed as the Federal Information Processing Standards (FIPS) alpha state code.

(ii) Entry. Enter the appropriate Federal Information Processing Standards code for the state, e.g. "AL" for Alabama.

(5) NASIS site table: database county (on screen label: County).

(i) Definition. Database county is the name of the county or other division in which a particular National Soil Information System site resides.

(ii) Entry. Enter the county or other division name in mixed case.
Example: Lancaster (not Lancaster County)

(6) NASIS site table: database city (on screen label: City).

(i) Definition. Database city is the name of the city or other location in which a particular National Soil Information System site resides.

(ii) Entry. Enter the city or other name in mixed case.
Example: Temple

(7) NASIS site table: database office type (on screen label: Off Type).

(i) Definition. Database office type is the name for the type of office in which a particular National Soil Information System site resides.

(ii) Classes.

area	Area office
field	Field office
mo	MLRA office
nhq	National headquarters
nssc	National Soil Survey Center
project	Project soil survey office
state	State office
other	Other type of office

(iii) Entry. Enter the appropriate office type name.

(8) NASIS site table: database contact (on screen label: Contact).

(i) Definition. Database contact is the name of the primary contact person for a particular National Soil Information System site.

(ii) Entry. Enter the name in the form first name || last name in mixed case.
Example: Jane Doe

(9) NASIS site table: database phone (on screen label: Phone).

(i) Definition. Database phone is the phone number of the person identified by "database contact".

(ii) Entry. Enter the appropriate phone number.
Example: (402) 437-5423x1234

(10) Group table: group name (on screen label: Group).

(i) Definition. Group name is the name of a particular National Soil Information System group in a particular National Soil Information System site.

(ii) Entry. Enter the group name in mixed case.
Example: state office

(11) Group table: group description (on screen label: Description).

(i) Definition. Group description is a narrative text entry that contains information about a particular National Soil Information System group.

(ii) Entry. Enter text as desired.

(12) Group table: group contact (on screen label: Contact).

(i) Definition. Group contact is the name of the primary contact for a particular National Soil Information System group.

(ii) Entry. Enter the name in the form first name || last name in mixed case.
Example: John Doe

(13) Group table: group phone (on screen label: Phone).

(i) Definition. Group phone is the phone number of the person identified by "group contact".

(ii) Entry. Enter the appropriate phone number.
Example: (402) 437-5423x1234

(14) User table: user name (on screen label: User).

(i) Definition. User name is the name of a particular National Soil Information System user in a particular National Soil Information System site.

(ii) Entry. Enter the name of the user in the form of first name || last name in mixed case.
Example: John Doe

(15) User table: unix user name (on screen label: Login).

(i) Definition. Unix user name is the UNIX user name of a particular National Soil Information System user, i.e. the name the user enters when logging into UNIX. The combination of **user name** and **unix user name** is how National Soil Information System makes the association between a particular National Soil Information System user and a particular UNIX login ID.

(ii) Entry. Enter the "user's" UNIX login.

(16) User table: user description (on screen label: Description).

(i) Definition. User description is a narrative text entry that contains information about a particular National Soil Information System user.

(ii) Entry. Enter desired information. Perhaps the user's title, such as "Soil Dataset Manager" or "Soil Correlator".

(17) User table: user phone (on screen label: Phone).

(i) Definition. User phone is the phone number of the person identified by "user name".

(ii) Entry. Enter the appropriate phone number.
Example: (402) 437-5423x1234

(18) User table: dataset manager flag (on screen label: DSM).

(i) Definition. Dataset manager flag is notation that indicates if a particular National Soil Information System user has dataset manager privileges.

(ii) Entry. Choices are restricted to "yes" and "no".

(b) The query object.

The purpose of the query object is to maintain the name, selection criteria, description, and default target table developed for individual queries. Queries are used to select specific records from local NASIS data into a current NASIS session for viewing, editing, or reporting. Queries are also used to retrieve NASIS data from other NASIS sites. Query objects are created as needed and retained at the discretion of the owner of the query.

The query object comprises the query table. Ownership of a specific query object is indicated by the site and group columns in the query table. Authority to edit the query object is limited to users who are members of the group that owns the query.

A specialized editor is used to edit the selection criteria included in the query. Descriptions for data elements in the query object and instructions for use of the editor are in the National Soil Information System on-line documentation. Facilities to create and maintain query specification are under development.

(c) The report object.

The purpose of the report object is to maintain the style, format, content, and layout specifications developed for individual reports. Reports are used to view or print soil survey data.

The report object comprises several tables in the National Soil Information System. Facilities to create and maintain report specifications in these tables are under development.

Part 644 – DELIVERING SOIL SURVEY INFORMATION

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Part 644 – DELIVERING SOIL SURVEY INFORMATION

644.00 Definition and Purpose.

(a) Soil survey information is the analysis and summary of records gathered either during the initial inventory or added later to enhance the data assembled during the initial investigation and mapping. Soil survey information is distributed in a variety of forms and always includes a geographic component identifying either the spatial or point location of the information. Soil survey information describes, defines, and classifies the soils and interprets them for various uses. It documents the kinds, extent, location, and quality of the soils in the survey area. It contains soil interpretations appropriate for the intended uses of the soils. The memorandum of understanding for the soil survey area describes these uses.

(b) The purpose of soil survey information is to transfer knowledge to those who make decisions about soil use. Soil survey information may utilize several delivery systems and is represented by different soil survey products.

(c) The Natural Resources Conservation Service (NRCS) according to the authority outlined in Title 7 Code of Federal Regulation (October 8, 2004) Subpart B, sec. 611.10, part (a), conducts soil surveys under national standards and guidelines for naming, classifying, and interpreting soils and for disseminating soil survey information. This part of the National Soil Survey Handbook provides standards on dissemination of soil survey information.

644.01 Types of Soil Survey Delivery

(1) Soil survey information is delivered primarily through four online systems: Web Soil Survey, the Soil Data Mart, the National Soil Characterization Web application, and the Soil Geochemical Spatial Web application.

(a) Web Soil Survey

(2) The Web Soil Survey is the primary delivery mechanism for detailed soil survey information. This Web application has several delivery functions. It includes Web-based soil surveys with user-determined text and maps of areas of interest. The Web Soil Survey allows the user to interactively select an area of interest on the map, to view and print the soils map for the area-of-interest, to access soil data for the area, and to obtain information on the suitability of the soils for selected uses. The Web Soil Survey is a dynamic system; any corrections and enhancements made to the spatial and tabular data as a result of soil survey maintenance can be uploaded to the Soil Data Mart and thus made available through the Web Soil Survey. Although the information in the current version is detailed soil survey information, plans are to include general soil information and point data.

(b) Soil Data Mart

(3) The Soil Data Mart is an applications database of the official detailed soil survey tabular and spatial information and the general spatial and tabular data of the Digital General Soil Map of the U.S. (STATSGO). All data in this database have been certified for use. The Soil Data Mart allows the user to download tabular and/or spatial soil data and to view the tabular data as reports for individual survey areas. Downloading and viewing of the tabular data can be tailored to individual selections. A part of the National Soil Information System, the Soil Data Mart is the official source for soil information delivered through various applications such as the data mart, Web Soil Survey, and field office technical guides. The URL for the site is http://soildatamart.nrcs.usda.gov. Point data as pedon descriptions and laboratory data may be included in this database in the future.

(c) NSSC Soil Survey Laboratory Research Database Web Application

(4) The National Soil Characterization Data Website is an applications database that provides analytical data for pedons of U.S. and foreign soils from the Soil Survey Laboratory (SSL), National Soil Survey Center. Standard morphological pedon descriptions are available for most of these pedons. The data are available online at http://ssldata.nrcs.usda.gov/. They are point data.

(d) Soil Geochemical Spatial Web Application

(5) The Soil Geochemical Spatial Web Application is an ArcView-driven Web application. The geographic display consists of two major sets of geochemistry data:

(1) Current geochemical data. – These data are displayed in four geographic layers: Site Info, Major Elements, Trace Elements, and Selected Characterization Data.

(2) Holmgren Dataset. – These data were produced by the Soil Survey Laboratory during the 1970s and 1980s for a project documenting the content of selected trace elements in agricultural soils of the U.S. This database is available at: http://soils.usda.gov/survey/geochemistry/index.html.

644.02 Policy and Responsibilities.

(6) Title 7 CFR Subpart B paragraph 611.11 directs the NRCS to disseminate soil survey information to the public through electronically accessible maps and reports, electronic access to data files, or printed documents. To the extent limited by commonly accepted technology, soil survey information is disseminated in electronic form. NRCS is to make soil survey information available as soon as is practical following fieldwork or other soil survey activity that provides new soil survey information.

(b) Official soil survey information

(1) The official source of soil information is the Soil Data Mart, a part of the National Soil Information System.

(i) This system provides for the collection, storage, manipulation, and dissemination of detailed and general soil survey information.

(ii) The system includes certified tabular and spatial data at various scales.

(2) The goal is to distribute and maintain accurate and complete information on the current condition of the soils of the United States in a seamless sequence of spatial and tabular data.

(i) Soil survey information is published and issued to users soon after the completion of the fieldwork.

(i) Initial detailed soil survey information is to be posted when the spatial data is certified, the NASIS data is certified and both databases are ready to send to the Soil Data Warehouse; at least within 1 year after mapping is complete.

(b) Interpretations

(1) Interpretations are generated from soil property data and approved interpretation criteria.

(2) Interpretations used in disseminating soil survey information are extracted directly from information hosted on the Soil Data Mart.

(3) The interpretation results are not modified or adjusted individually in any way. They are the results generated by the criteria.

(c) Responsibilities

(1) The **MLRA Soil Survey Office** is responsible for:

(i) creation and maintenance of fully populated soil survey databases in the National Soil Information System with the properties to generate tables of soil survey information and interpretations for all soil surveys in their assigned area;

(ii) detailed soil mapping for digitized and certified detailed soil spatial data;

(iii) primary authorship and preparation of soil survey manuscripts for complete soil survey publications;

(iv) developing technically correct, consistent, complete, current, organized, clear, and concise soil survey manuscripts;

(v) responding to the customer needs and expectations defined in the memorandum of understanding;

(vi) meeting NCSS standards;

(vii) preparing illustrations and photographs;

(viii) requesting the assistance of staff specialists for soils and other disciplines, as needed; and

(ix) developing schedules and meeting established dates.

(2) The **MLRA Soil Survey Region Office** is responsible for:

(i) ensuring that detailed and general soil survey products and information conform to NCSS standards;

(ii) providing support and leadership to the project office in describing soil properties and making estimations used as data elements;

(iii) providing support and leadership to the project office in preparing soil survey manuscripts and maps and the processes involved, such as map compilation and digitizing;

(iv) ensuring that soil survey products and information are technically correct, consistent, complete, current, and organized in a clear and concise manner;

(v) ensuring that soil survey information reflects current local conditions and needs;

(vi) providing training to authors;

(vii) recommending the action needed to correct an error in a database;

(viii) monitoring the key dates in the Soil Survey Schedule and assisting the project office in keeping the soil survey on schedule;

(ix) ensuring multidiscipline and cooperator input when soil survey information is prepared and reviewed;

(x) editing, formatting, proofreading, and preparing text and tables for soil survey manuscripts; and

(xi) ensuring conformity of publications to the Government Printing Office Style Manual.

(3) The **State Office** is responsible for:

(i) certifying and posting official detailed soil survey information in the Soil Data Mart;

(ii) populating and maintaining general soil information in the NASIS database and submitting to the national coordinator for the Digital General Soil Map of the U.S.;

(iii) developing criteria for local or state interpretations, as needed;

(iv) selecting the appropriate tables of detailed soil information for use within the Soil Data Mart;

(v) developing a program that ensures equitable distribution of soil survey information and products; and

(vi) populating the electronic field office technical guide (eFOTG) with soil survey information from the Soil Data Mart.

(4) The **National Soil Survey Center** is responsible for:

(i) developing national standards and procedures for disseminating soil survey information;

(ii) developing national interpretations using detailed and general soil survey information;

(iii) maintaining the general soil information data set;

(iv) maintaining a national list of published soil surveys, including out-of-print surveys; and

(v) providing for the delivery of soil survey information on Web delivery tools.

(5) The **National Cartography and Geospatial Center** is responsible for:

(i) quality of the electronically disseminated maps on the Web and on the CD-ROMs.

644.03 Soil Survey Products.

Soil survey information is assembled at various scales to meet the needs of various customers. The product types are:

(a) Point soil data. These are data that are sampled in one location.

(1) Point data include pedon description data and lab characterization data that are geo-referenced. Some of this information is currently delivered:

(i) through the laboratory characterization database or

(ii) within printed publications, such as soil survey reports and soil survey investigation reports.

(2) Most point data gathered as field documentation for soil survey are now captured within the National Soil Information System but are not made available elsewhere.

(b) Detailed soil survey information.

(1) This information consists of soil survey spatial data (soil maps or digital data) and reports, such as the standard product of detailed soil surveys, and generally is at a scale of either 1:12,000 or 1:24,000.

(2) This information is delivered by the Soil Data Mart and Web Soil Survey.

(c) Complete soil survey publication. The complete soil survey publication includes materials and sections identified in Exhibit 644-1. The complete soil survey publication:

(1) Includes detailed soil survey information and other explanatory information.

(2) Is delivered as standardized PDF files of text, tables, and maps both by CD-ROM and in the Web Soil Survey as a soil survey manuscript.

(3) New or old, whether published in printed form, on CD-ROM, or on the Web, is listed on the national list of published soil surveys, which is maintained by the National Soil Survey Center at http://soils.usda.gov/survey/printed_surveys/. This site includes the list of completed soil survey publications, information on ordering printed copies or CD-ROMs, and information about online soil survey publications.

(d) **General Soil Map of the U.S.** This dataset includes both spatial and tabular data.

(1) The level of mapping is designed for maps to be used for broad planning and management covering state, regional, and multi-state areas.

(2) Soil maps for the General Soil Map of the U.S. database are produced by generalizing the detailed soil survey data.

(3) The mapping scale for the general soil map is 1:250,000 (with the exception of Alaska, which is 1:1,000,000).

(4) Web access to the Digital General Soil Map of the U.S. is provided with capability to download data within the Soil Data Mart.

(5) Eventually, online viewing and analysis of the Digital General Map will be part of the Web Soil Survey.

(e) **Major Land Resource Areas of the United States.** The map of the Major Land Resource Areas of the United States is a generalization of the map units in the General Soil Map of the U.S. Some line work is also taken from USFS and USEPA ecoregion maps.

(1) Delineations are compiled to a base map of 1:250,000 and displayed at scales of 1:3.5 million to 1:7.5 million. Currently, no tabular database has been developed for this data layer.

(2) All connected soil data are in text fields, except for National Resource Inventory data. However, the MLRA map is linked to a companion dataset, called Common Resource Areas, that has linkages to short narratives and the Conservation Systems Guides (CSGs) database, used by the field office technical guide.

644.04 Development of Point Data

(3) Point data become a product of soil survey when they are incorporated into the database. These data include soil profile descriptions, soil water or temperature measurements, transects, field notes, and data derived from characterization or engineering test laboratories.

644.05 Development of Detailed Soil Survey Information

(4) Detailed soil survey information becomes a product of soil survey when it is entered into the Soil Data Warehouse. It includes all soil map unit and component information and spatial information.

644.06 Development of a Complete Soil Survey Publication.

(a) **Planning.**

(1) The memorandum of understanding for the soil survey area is the guidance document for soil surveys from design to delivery. It must be specific, and signers must commit to its contents.

(2) The workload analysis identifies the tasks and the timeframe to complete each task. Part 608.05 provides more information. Part 608.09 provides information on scheduling. Exhibit 608-1 identifies the basic activities that must be completed.

(3) During the initial field review, the project office and the MLRA office assign each section of the manuscript to an author. They also identify dates for completion.

(4) The layout and design of a "complete soil survey publications" are standardized so that the publications have a consistent corporate look and meet government standards. Flexibility is available to authors in the presentation of this soil survey information, as outlined in Exhibit 644-1, which indicates required and optional sections. The content should meet the needs of the intended users. These needs are identified in the memorandum of understanding.

(b) Quality Control and Assurance.

(1) Progressive correlation and certification help to resolve soil survey problems and meet soil survey needs throughout the course of the soil survey project. The MLRA office assists the project office during the project activities, including manuscript preparation, to ensure the timely completion of the manuscript and database and conformance to standards.

(2) The author(s) and the MLRA office control the technical quality of a soil survey manuscript. Technical specialists in such fields as range, forestland, wildlife, and engineering provide assistance.

(3) The MLRA office and technical specialists review the soil survey manuscript and database for technical accuracy and adherence to standards. Quality control occurs during each stage in the project. The editor and soil scientists on the MLRA office staff control the quality of the text and maps. The MLRA office certifies the soil survey legend, descriptions, database, mapping, and manuscript during progressive reviews.

(4) The National Cartography and Geospatial Center controls the quality of printing the CD-ROMS.

(c) Ordering Copies.

(1) The state conservationist submits a consolidated state order for CD-ROMs or print copies of surveys and map copies on form NRCS-SOI-7 to the National Cartography and Geospatial Center about 3 months before manuscript completion. Exhibit 644-2 is an example of the form. Include the shipping addresses of those locations receiving copies.

(i) The state conservationist coordinates with the cooperating agencies and libraries, institutions, and officials of interested agencies. Up to 1000 CD-ROMs and 500 sets of maps can be ordered.

(ii) Each cooperating agency is entitled to 50 copies of the published soil survey on CD-ROM at no cost.

(iii) In special situations, where printed and bound copies are required, approval by the Director of Soil Survey is required. The state conservationist will indicate on the NRCS-SOI-7 the number of copies to be printed on paper and the number to be published on CD-ROMs.

(iv) Prior to final publication, the state conservationist checks the submitted form NRCS-SOI-7 to ensure that it still is current. The state conservationist notifies the National Cartography and Geospatial Center of any change in the number of copies ordered. The revised form NRCS-SOI-7 must be received before the survey is sent for the production of CD-ROMS.

(2) Senators and Representatives are informed of the availability of the publication. Refer to Exhibit 644-3 for a sample.

(d) Printing Requirements and Options for Soil Surveys.

(1) Soil survey publications are issued only as electronic copies of text and maps on CD-ROMs and/or on the Web; however, maps may be available as flat maps where printing from electronic media is not feasible. Printing of paper copies of the text requires special approval by the Director of Soil Survey.

(2) All surveys must be sent to the National Cartography and Geospatial Center for the production of original CD-ROMs and electronic files. States and cooperators can produce copies of issued CD-ROMs as needed.

(3) The National Cartography and Geospatial Center maintains the printing materials for maps. States ensure that other printing materials, such as photographs, are stored for future use.

(4) Electronic files can be provided to cooperators and others, who can then produce additional copies of the survey for distribution or sale to the public.

(e) Detecting and Correcting Errors in Printed Copies of Published Soil Surveys.

(5) Printing and binding errors include blank pages, duplicate or missing pages, poor binding, misplaced pages, and blurred print. Some errors may occur in every copy of the survey. They include missing paragraphs, misplaced captions, wrong entries in tables, and defective maps. Determine the extent of the error before selecting a corrective action. The National Cartography and Geospatial Center can provide assistance to the state soil scientist in determining the corrective action to be taken.

(f) Distributing a Published Soil Survey.

(1) When the soil survey publication of an area is printed on a CD-ROM or other electronically readable media, the National Cartography and Geospatial Center notifies the state conservationist to expect delivery of the publication. The state conservationist and the cooperating agencies implement their marketing plan and distribute the soil survey to maximize its utilization.

(2) The distribution ensures that each published soil survey is available to all people, regardless or race, color, national origin, sex, religion, marital status, or age. The distribution may entail printing paper copies from the CD-ROM or downloaded from the Web.

(3) Prior to distribution, check all copies. Be sure all sections of the PDF files open properly. Also, check maps if they are printed separately. Report errors to the state soil scientist, who in turn notifies the National Cartography and Geospatial Center.

644.07 Development of the Digital General Soil Map of the U.S.

(a) Digital General Soil Map of the U.S.

(1) The basis for the Digital General Soil Map of the U.S. is the former State Soil Survey Geographic Database (STATSGO2). This database includes spatial and tabular data.

(2) It uses the Geographic Coordinate System with North American Datum (NAD) 1983.

(3) This database is established and managed as one data set; however, states are required to fully populate a minimum data set of properties.

(4) Data will be refreshed annually. The database uses a standard state boundary vector and the National Atlas Coastline.

(5) The Soil Data Mart (SDM) and the Web Soil Survey (WSS) are desired public distribution points.

(b) This data set provides:

(1) a nationally consistent soil geographic database;

(2) soil data compatible with other data digitized from 1:250,000-scale maps, such as land use/land cover, political boundaries, and federally-owned land;

(3) soil information at a level of detail for a state or broader geographic information system;

(4) a set of consistent, joined county general soil maps of the same scale used for a state or broader geographic information system;

(5) maps for interim general soil data for areas where digital detailed soil survey maps are not complete;

(6) general soil data to determine optimal locations for various uses;

(7) general soil maps for publications in soil survey and watershed reports; and

(8) a tool for use with other resource information for the state, region, or nation in a geographic information system.

(c) Components of the General Soil Map of the U.S.

(1) In general, map units are a combination of associated phases of soil series that enable the most precise interpretations. Where soil series are not established or are not adequately described, some map units are combinations of associated taxonomic subgroups or families. Components are also miscellaneous land types, such as Rock outcrop, Dune land, and Playas. Water areas not large enough to be delineated, but of sufficient composition, will be included as components of map units.

(2) Map units have a maximum of 21 soil components. The percentages of the components of a map unit add up to 100 percent. Highly contrasting components are kept separate, even though they are of minor extent. For instance, 1 percent Rock outcrop is significant and should be identified in the composition.

(3) Not all components are in all delineations of a general soil map unit, and the composition percentage may vary by delineation.

(4) The information about map units includes reliable estimates of the components and their composition percentages. The methods by which the composition was determined is included. Composition is determined by using transects, measuring components, or calculating in a geographic information system from digital Soil Survey Geographic (SSURGO) data. Transects are commonly located and examined on soil survey field sheets.

Exhibit 644-1 Required and Optional Sections of a Soil Survey Publication

Accessibility statement	Required
Cover	Required
"How To Use This Soil Survey"	Required
"Box" information and EEO statement	Required
Contents	Required
Foreword (or Preface)	Required
"General Nature of the Survey Area"	
Introductory information and locator map	Required
Climate tables and "Climate" section	Optional (link to WCC)
Other sections, such as "History," "Natural Resources," and "Transportation Facilities"	Optional
"How This Survey Was Made"	Required
"Survey Procedures"	Optional
"General Soil Map Units"	Optional link to Digital General Soil Map of the U.S.
Detailed soil map unit descriptions	Required
"Use and Management of the Soils" and interpretive tables	Required but only for relevant uses (Cropland, pasture, woodland, range, wildlife habitat, recreation, and engineering uses are all optional, depending on relevancy.)
"Land Capability Classification"	Required
"Prime Farmland"	Required if relevant
"Soil Properties" and properties tables	
"Engineering Index Properties"	Required
"Physical Properties"	Required
"Chemical Properties"	Required
"Soil Features"	Required
"Water Features"	Required
"Physical and Chemical Analyses of Selected Soils"	Optional (link to NSSL data)
"Engineering Index Test Data"	Optional
"Classification of the Soils" and classification table	Required
Series descriptions	Optional (link to OSDs)[1]
"Formation of the Soils"	Optional
References	Required
Glossary	Required
General soil map	Optional link to Digital General Soil Map of the U.S.
Detailed soil maps	
Detailed map sheets	Required
"Index to Map Sheets"	Required
"Conventional and Special Symbols Legend"	Required
"Soil Legend"	Required
Photographs	Optional
Block diagrams and other drawings	Optional

[1] As we have progressed to automated development and delivery of soil survey information, taxonomic descriptions (series or higher taxa) are not required for a manuscript to meet minimum standards. Please note that you are not prohibited from publishing these descriptions, including the option to use the OSD. The MLRA regional office leader in the region may have additional insight and suggestions about this.

GENERAL INTRODUCTION

Soil Survey Manuscript Format

Soil survey publications on CD-ROM include the soil descriptions, interpretations, and maps published on one disk. Flexibility is available for MLRA offices that desire to have additional maps printed.

Editing Prewritten Material

Authors should use the latest version of the prewritten material distributed by the MLRA office. This material introduces major sections and describes the tables used in soil surveys. It should be edited only as needed. Authors need to ensure that table letters are changed to the appropriate numbers and that statements that misrepresent the survey area are changed or deleted. They should not, however, delete rating factors when these factors are not limitations in the survey area. The factors were considered when the soils were rated. Deleting references to them implies that they were not considered.

A. COVER
This is prewritten material. The names of cooperating agencies are to match the "Classification and Correlation Document."

B. HOW TO USE THE SURVEY
A page entitled "How To Use This Soil Survey" is inserted into the text by the editorial staff prior to sending the manuscript for publication. This page is included as part of the electronically generated prewritten material.

C. CREDITS
This page is referred to by the editorial staff as the "box." It is prewritten material. Dates and cooperators are to match the "Classification and Correlation Document." Credit for financial or other assistance by agencies other than cooperators can be given at the end of the second paragraph on this page. Insert the caption for the cover photo.

D. CONTENTS
This is prewritten material with addition or deletion of headings as needed. Series names are to match the correlation document. The table of contents must accurately represent the actual contents of the survey. Do not list page numbers.

E. FOREWORD
This is prewritten material with insertion of the name of the survey area and the state conservationist's name. (Note: If the state conservationist's name is not used, change "Foreword" to "Preface"; be sure also to change the listing in the table of contents.)

F. TITLE PAGE
This is prewritten material. Fill in the name of the survey area, the author's name, and the names of soil survey project members. Fill in the names of the cooperating agencies as they appear in the correlation document.

G. INTRODUCTION TO THE SURVEY AREA
This part of the survey is not assigned a heading. A few short paragraphs describe the location of the survey area, the size of the area, and some important facts about the area. If a soil survey of the area or part of the area has been previously published, it is pointed out that this survey supersedes the older one. Make sure that the older published survey is cited in the list of references.

H. GENERAL NATURE OF THE SURVEY AREA

This section highlights the natural and cultural features in the survey area that affect the use and management of the soils. Brief discussions of the history and development of the area, climate, physiography, drainage, natural resources, farming, etc., can be included. If history and development are described, the emphasis should be on land use. Significant trends in population and in soil use can be described. A discussion of the trends in land use is especially appropriate for survey areas that have been subject to recent extensive changes. Data from census or other sources should be supported by appropriate references. This section should give the reader a general impression of the area.

Information given in the introduction to the survey area is not repeated. Technical material does not belong in this section. If general enough for the lay reader, a brief discussion of the geology of the survey area can be included here. A highly technical discussion belongs in the section on "Formation of the Soils."

The climate section is required as either a link to the Climate Data Access Facility or as a section. If possible, use the prewritten material. MLRA offices are encouraged to use the automated climate tables from the Climate Data Access Facility located in Portland, Oregon. The standard "normal" period of 1971 to 2000 is used, but long term or climates of other periods can supplement this required period.

I. HOW THIS SURVEY WAS MADE

This is prewritten material with the following additions. Explain all locations that are not exactly joined briefly at the end of this section. Explain a blank or unmapped area on the map within the boundaries of the survey. Is the area unmapped because it is a restricted military installation or because access was denied? The purpose of the survey procedures section is to describe and document specific procedures used to make or update the soil survey.

J. GENERAL SOIL MAP UNITS

The general soil map, if used, is a subset of the Digital General Soil Map of the U.S.. This section consists of prewritten material, general soil map unit descriptions, and a discussion of broad land use considerations. The broad land use considerations part is optional. Three-dimensional block diagrams and cross-sectional diagrams that show the location of the major soils of a general soil map unit on a landscape and their relationship to underlying material is optional.

K. DETAILED SOIL MAP UNITS

Map unit descriptions, if used, provide users in nontechnical terms the typical profile of the named soil or soils, information about the basic soil interpretations and management concerns that could reasonably be expected for the common land uses. Map unit descriptions are written in a way that will help the reader understand the behavior of the soils within a survey area. If detailed soil map units are used they must add value to the information provided in the tables. The descriptions sequence is:

(1) Map symbol and map unit name
(2) Major features, setting, and composition
(3) Brief soil profile
(4) Included areas
(5) Soil properties and qualities
(6) Use and management
(7) Interpretive groups

The information in the use and management section of the map unit description is intended to alert the user to significant problems or qualities of the soil. The discussion should be brief, concise, and informative. The description of the major hazards and management concerns must be consistent with the assigned interpretive groups.

L. USE AND MANAGEMENT OF THE SOILS

This section gives, mainly in tables, information applicable to the use and management of the soils. It discusses yields and suitability or potential and limitations of the soils for major land uses. There is a prewritten explanation for each table. In addition, there are discussions of general management concerns and practices applicable to all soils that are used for a particular purpose, such as crops and pasture

M. SOIL PROPERTIES

Data about soil properties are listed in tables in this section. All tables are generated by the soil data mart. Information includes estimates of engineering index properties, physical and chemical properties, and soil and water features. Also, available field and laboratory data are given in this section.

N. CLASSIFICATION OF THE SOILS

This section consists of a brief description of the system of soil classification and tables. Taxonomic unit descriptions define the range in characteristics of a soil series as mapped within the major land resource area or utilize or link to the official soil series descriptions. The description is written for those individuals who need a detailed technical description of the soil and the associated range in characteristics.

O. FORMATION OF THE SOILS

This section allows soil scientists to record their concepts of the soil genesis in the survey area. The formation of the soils section can be an important part of the manuscript because it describes the models used by soil scientists in making the soil survey, however, the section is optional. This information is useful to soil scientists as well as other users of the soil survey.

P. REFERENCES

References are to be shown in the reference section only. List only the references cited in the text. Previously published soil surveys of the area should always be cited.

Q. GLOSSARY

A glossary is required. The glossary defines terms, words, and phrases in the manuscript that are likely to be unfamiliar to most readers.

R. TABLES

All tables are exact replicas of the tables extracted from the soil data mart. No adjustments are made to these reports.

S. ILLUSTRATIONS

Illustrations help convey important facts to readers. They relate specifically to the soils shown on the map and to places within the survey area. Each illustration must be referred to in the text. Photographs and drawings, such as maps, diagrams, and charts, are useful types of illustrations.

Exhibit 644-2 Record Sheet for Collating State Orders for Published Soil Surveys

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-SOI-7
7-96

RECORD SHEET FOR COLLATING STATE ORDERS FOR PUBLISHED SOIL SURVEYS

Soil Survey of

I. NRCS ORDER	*SHIPPING ADDRESS*	COPIES
A. FREE COPIES TO COOPERATING AGENCIES. AGENCY		
B. COPIES TO BE BOUGHT BY COOPERATING AGENCIES *(Attach a signed copy of the purchase agreement)* AGENCY		
C. COPIES FOR STATE NRCS OFFICES, STATE OFFICE		
AREA OFFICE		
FIELD OFFICE		
OTHE R*(specify)*		
D. COPIES FOR USE BY NRCS NATIONAL OFFICE		**21**
E. TOTAL NRCS ORDER. ADD ITEMS I A-D.		21

II. EXTRA SOIL MAP **(unbound and printed front only)** *FOR NRCS.*	*SHIPPING ADDRESS*	*COPIES*
A. SETS OF COMPLETE SOIL MAP AS IN PUBLISHED SOIL SURVEY.		
B. SETS OF COMPLETE SOIL MAP WITHOUT AERIAL PHOTO BACKGROUND.		
C. SETS OF AERIAL PHOTO BACKGROUND ONLY.		
D. COPIES OF GENERAL SOIL MAP WITH COLOR TINTS.		
E. COPIES OF GENERAL SOIL MAP WITHOUT COLOR TINTS.		

DO NOT WRITE IN THIS BOX TOTAL NRCS *(USDA)* ORDER FOR GPO: = SIGNED AND DATE: ______________	SIGNED: STATE CONSERVATIONIST	DATE:

This form was electronically produced by National Production Services Staff

Exhibit 644-3 Example of Letter to Senator -- Notification of Availability of Soil Survey.

Honorable ______________________
United States Senate
Washington, D.C.

Dear Senator ______________________:

The National Cooperative Soil Survey (NCSS) is a nationwide partnership of federal, regional, state, and local agencies and institutions. Partners in NCSS work together to inventory, document, and interpret the soils of the United States and its trust territories and to disseminate information about the soils.

The Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture, is responsible for leadership of the National Cooperative Soil Survey. We have completed a soil survey titled ______________________. This soil survey is now available at the State Office of NRCS in ______________________ and on the Web at: http://soils.usda.gov/survey/

Sincerely,

State Conservationist

cc:

______________________, Chairperson, ______________________ Conservation District

Part 647 SOIL MAP DEVELOPMENT

Table of Contents

Part 647 SOIL MAP DEVELOPMENT

647.00 Definition and Purpose.

Soil map development includes activities related to the preparation and completion of maps for soil survey. The purpose is to provide current and accurate soil maps (digital and analog) and related products to users. Four functional areas describe the major cartographic procedures: imagery acquisition, map compilation, digital data capture, and map finishing.

(a) Imagery Acquisition

Field mapping in soil survey relies on aerial photography as base imagery. Publications and SSURGO development use orthophotography where it is available. Generally about two years before the start of the soil survey, the memorandum of understanding initiates the acquisition of imagery for mapping and publication. Part 647.02 explains acquisition of imagery.

(b) Map Compilation

Map compilation is the accurate transfer of map information from soil survey field sheet imagery to publication imagery or map bases for digitizing, and the accurate conversion or correlation of soil map unit symbols and features to approved legends.

Standard compilation techniques encourage precise transfer of information from soil survey field sheets to approved map bases for digitizing and map finishing.

(c) Digital Data Capture

Digital data capture or digitizing is the process of converting information shown on analog maps into digital form for computer processing. Mapping on hard copy aerial photography, subsequently compiling to orthophotography, and hand- or scan- digitizing are avoided if at all possible. Field mapping is done using electronic media and on-screen digitizing as much as possible to avoid these extra steps.

This part establishes digital standards and specifications for the digital soil survey map component of the Soil Survey Geographic (SSURGO) database.

(d) Map Finishing

Map finishing is the final transfer of line work and text to a product ready for press negatives.

647.01 Policy and Responsibilities.

(a) Policy

(1) The publication scale for new and updated soil surveys is 1:12,000 or 1:24,000. (Alaska for 1:25,000 and the Caribbean for 1:20,000 are excepted.) Other scales require approval by the Director, Soil Survey Division, of the Natural Resources Conservation Service.

(2) All new and updated soil surveys are to be digitized and SSURGO certified.

(3) The publication format for a map is 3.75 minute or 7.5 minute quadrangle. Soil maps for publication of new and updated soil surveys rely on digital map finishing. This process captures all correlated map features in the publication in a digital format.

(4) An approved and signed memorandum of understanding for the soil survey area must be on file at the NRCS National Soil Survey Center, Lincoln, Nebraska, and the NRCS National Cartography and Geospatial Center, Fort Worth, Texas, before processing a request to order imagery. Part 606.01(a)(5) and Exhibits 606-1 and 606-2 provide additional information on the memorandum of understanding.

(5) Soil surveys use the definitions and applications of soil survey features on NRCS-SOI-37A in Exhibit 627-5. Definitions of ad hoc features are the responsibility of the MLRA regional office.

(b) Responsibilities

(1) The **Federal Geographic Data Committee and the Office of Management and Budget** formally assigned the responsibility for national coordination of digital soil data to the NRCS. Refer to Office of Management and Budget Circular A-16, for more information.

(2) The **Natural Resources Conservation Service** (NRCS) has the Federal responsibility for the National Cooperative Soil Survey and Federal leadership for:

(i) collecting, storing, maintaining, and distributing soil information on privately owned lands in the United States. These activities include
- preparing compilation bases for digitizing and map finishing
- performing the quality assurance of soil survey maps, and
- preparing map materials for publication.

(ii) NRCS also has the lead Federal responsibility in collecting, archiving, and distributing the Soil Survey Geographic (SSURGO) database.

(3) The **MLRA soil survey office** is responsible for:

(i) achieving an exact or acceptable join as described in the NSSH 609.03 and specified in the memorandum of understanding,
(ii) supervising map compilation (or coordinate with dedicated map compilation units if established) in preparation for digitizing and publication as described in NSSH part 647,
(iii) quality control of map compilation activities (100% check),
(iv) quality control of all phases (soil business) of soil surveys,
(v) initiating documentation on discrepancies of joins, and
(vi) the total scientific quality, including accuracy, completeness, and logic, of all soil survey maps in the soil survey area. Part 609.05 provides additional information.

(4) The **MLRA regional office** is responsible for:

(i) assuring all aspects of active soil survey projects,
(ii) assuring that exact or acceptable joins are achieved as specified in the memorandum of understanding,
(iii) performing correlation activities in a manner that will lead to a seamless coordinated soil survey throughout MLRAs and between MLRAs,
(iv) assuring the definitions of ad hoc features,
(v) approving all correlation documents, including amendments to previously correlated surveys, in coordination with the appropriate state conservationist,
(vi) assuring the quality of all map compilation/recompilation/digitizing through a 10% check and certification (a locally administered certification process may be established where dedicated compilation units exist),
(vii) informing states of any deficiencies in work submitted for review. Assisting states with the resolution of these problems,
(viii) assuring the quality of soil databases and tables,
(ix) assisting states in the preparation of metadata,
(x) coordinating with states as needed for delivery of all map materials, soil data, and metadata to the digitizing unit for processing,

(xi) coordinating and providing quality assurance for products of map digitizing and finishing,
(xii) coordinating the certification letter with digitizing units and appropriate state conservationists,
(xiii) initiating plans for completing an exact join between soil surveys that do not have an exact join.

(5) The **state office** is responsible for:
(i) obtaining all map materials needed in the state to perform map compilation/recompilation activities, including those needed for a check of joins with other survey areas,
(ii) coordinating with MLRA soil survey offices in the state concerning the flow of map compilation work,
(iii) determining priorities for soil survey areas to be digitized within each state,
(iv) identifying and working with organizations outside of NRCS that can help us achieve our digitizing goals and coordinating with digitizing units, digital map finishing sites, and MLRA regional offices concerning these activities,
(v) deploying sufficient staff to achieve agreed upon goals for the digitizing initiative,
(vi) reviewing joins with surrounding surveys and making corrections in coordination with the MLRA regional office to achieve an exact join for recompilation of existing surveys,
(vii) supervising recompilation (or coordinating with dedicated map compilation units if established),
(viii) quality control of map recompilation activities (100% check),
(ix) initiating correlation amendments/supplements through the MLRA regional office as needed for recompiled soil surveys,
(x) preparing and providing metadata for all compiled/recompiled surveys from the state which are submitted to digitizing units (through the MLRA regional office) for digitizing,
(xi) certifying and downloading soil tabular data for SSURGO for all compiled/recompiled surveys from the state which are submitted to digitizing units (through the MLRA regional office) for digitizing,
(xii) after passing digitizing quality control and quality assurance checks: certifiying SSURGO and archiving to the Soil Data Warehouse,.
(xiii) archiving certified SSURGO to the Soil Data Warehouse, at which time it is automatically publicly distributed via the Soil Data Mart, Web Soil Survey, and Geospatial Data Gateway.
(xiv) In-house distribution of SSURGO among NRCS field offices,
(xv) providing to a digital map finishing site all layers for publication in digital format compatible with digital map finishing processes.

(6) Digitizing units are responsible for:
(i) coordinating compilation/recompilation and soil business activities with states and MLRA regional offices to ensure an orderly flow of work for all soil surveys which are to be digitized by the unit,
(ii) performing certification review of submitted materials,
(iii) notifying MLRA regional offices of any problems discovered during certification review which require action by the MLRA regional office or states prior to certification,
(iv) digitally capturing compiled map materials including scanning soil lines, labeling, edge matching, and digitizing linear and point features,
(v) performing quality control of final digital data including spatial (100 % hardcopy check plot review by producing mylar check plots), tabular, and metadata,
(vi) coordinating with the MLRA regional office to obtain a SSURGO (Exhibit 647-5) letter from the state conservationist of the state whose survey is digitized, and
(vii) exporting the spatial data to the staging server

(7) Digital map finishing sites are responsible for:

- (i) electronically preparing soil survey maps for negative preparation by the National Cartographic and Geospatial Center,
- (ii) coordinating soil business activities with states and MLRA regional offices to ensure and orderly flow of work for all soil surveys which are to be map finished at the site, and
- (iii) performing quality control with 100 percent edit.

(8) The **National Cartography and Geospatial Center** is responsible for:

- (i) providing training in SSURGO quality assurance activities,
- (ii) providing technical assistance to states, MLRA regional offices, and digitizing units in spatial, tabular and metadata development to meet SSURGO specifications,
- (iii) assisting digitizing units with error resolutions to successfully import spatial data to staging server,
- (iv) assisting states with resolving problems related to committing SSURGO datasets to the Soil Data Warehouse,
- (v) communicating changes/updates and enhancements to SSURGO standards, certification routines and procedures,
- (vi) performing 10% quality review of SSURGO materials (spatial layer and metadata) documenting SSURGO spatial and tabular discrepancies, and forwarding findings to digitizing units, MO office, and other digital capture entities,
- (vii) developing and updating map compilation and digitizing techniques and standards,
- (viii) coordinating and implementing software updates to reflect changes in standards, and
- (ix) providing digital map finishing processes, procedures, and training to offices conducting digital map finishing,
- (x) archiving, distributing certified SSURGO and Digital General Soil Map data (Gateway and Electronic Media),
- (xi) developing and maintaining SSURGO and other geospatial standards, protocols, specifications and training,
- (xii) migrating new data set boundaries into the Soil Data Warehouse,
- (xiii) updating SSURGO status map on the Soil Data Mart,
- (xiv) developing and providing Digital Map Finishing processes, standards, protocols, specifications and training,
- (xv) performing 10% quality assurance review of digital map finishing materials,
- (xvi) coordinating and implementing geospatial software updates to reflect changes in standards and specifications.

(9) The **National Soil Survey Center** is responsible for:

- (i) developing standards, guidelines, and procedures for all aspects of soil survey work, soil map development, and SSURGO certification,
- (ii) developing and applying geographic information systems for use with soil survey activities; and
- (iii) developing, maintaining, and improving soil survey geographic databases.
- (iv) providing technical assistance in population of the NASIS database.

(10) The **Soil Survey Division** is responsible for:

- (i) reviewing and monitoring the SSURGO development process,
- (ii) issuing policy,
- (iii) coordinating with states, MLRA regional offices, National Cartography and Geospatial Center, and National Soil Survey Center on soil survey compilation, digitizing, and map finishing issues.

647.02 Imagery.

(a) Initiation of Imagery Acquisition

Acquisition of imagery for mapping and publication of soil surveys begins about 2 years before fieldwork is to begin. It starts with a memorandum of understanding (MOU) between the Natural Resources Conservation Service and the State and local governments, universities, or other cooperating entities. For more information about the memorandum of understanding, see part 606. Responsibilities and intentions towards digitizing and map finishing are part of a soil survey area MOU or an amendment to an MOU.

(1) To acquire imagery*:*

(i) The MLRA Region-wide memorandum of understanding, approved by the Director, Soil Survey Division, must be on file at the National Soil Survey Center and the National Cartography and Geospatial Center. Optional memoranda of understanding for intial soil surveys and for update soil surveys that require extensive revision may also be on file. Refer to part 606.01.

(ii) Use the on-line NCGC Ordering System at http://www.ftw.nrcs.usda.gov/ncgcos to acquire imagery from the National Cartography and Geospatial Center. The ordering system was developed to streamline the process of ordering products and services from NCGC. The NCGC Ordering System replaces the Carto-19. Items such as imagery and orthophotography, map compilation materials, publication of soil survey products, SSURGO and digital map finishing standards, and status graphics are available throughthe on-line ordering system

(2) To acquire imagery for a ***soil survey update:***

(i) Send a written request to the National Soil Survey Center from the MLRA regional office and the state conservationist for approval to update a published soil survey. The Soil Survey Division responds by letter to requests to update National Cooperative Soil Survey projects.

(ii) Obtain Division approval before making any agreements that bind the Natural Resources Conservation Service with State or local governments, universities, or other potential cooperators.

(iii) Use the National Cartography and Geospatial Center on-line ordering system at http://www.ftw.nrcs.usda.gov/ncgcos for acquisition and preparation of the imagery after approvals and agreements are complete.

(b) Delivery Time Schedules of Imagery

(1) **Aerial Photography.**– Order aerial photography for field mapping from the National Cartography and Geospatial Center. Allow 4 to 6 months for delivery to the field office.

(2) **Digital Orthophotography.**– Order digital orthophotography from the National Cartography and Geospatial Center. Allow a minimum 13 months for delivery of a soft copy of the digital orthophotography and 16 months for a hard copy reproduction.

(c) Imagery Acquisition Assistance.

(1) **The National Cartography and Geospatial Center (NCGC) assists states** to acquire aerial photography and orthophotography. This assistance is available whether funding is from the states or by the Soil Survey Division. The NCGC will:

(i) Provide information on imagery availability

(ii) Order imagery

(iii) Inspect imagery to ensure quality and coverage

(iv) Provide digital orthophoto quadrangles on hardcopy

(v) Duplicate digital orthophoto quarter-quadrangles on CD-ROM media.

(d) Archiving

(1) **Aerial Photography**.– The National Cartography and Geospatial Center does not archive aerial photography. The Federal Records Center, Fort Worth, Texas archives the designated official field sheets after the survey is published.

(2) **Orthophotography**.– The National Cartography and Geospatial Center retains copies of all orthophotography acquired for use in the National Cooperative Soil Survey program. Reproductions of archived digital orthophotography are available upon request via the National Cartography and Geospatial Center on-line ordering system at http://www.ftw.nrcs.usda.gov/ncgcos.

(e) Preparation of Maps and Mapping Material

(1) Index to Field Map Sheets.– The National Cartography and Geospatial Center prepares an index to map sheets for ordered photography. The format of this index to map sheets corresponds with indexes prepared for publication of the soil survey.

The National Cartography and Geospatial Center includes a title block and special notes to aid the user in interpreting the information on the index to map sheets.

(2) Field Mapping Material.– Field mapping material can include aerial photography on paper or film positives. Aerial photography is available at publication scale.

(3) Publication Index to Detailed Map Sheets.– The National Cartography and Geospatial Center prepares an index to map sheets for orthophotography ordered for publication of soil surveys. Copies of the index accompany the compilation material sent to the state office.

The Center stores the original index to map sheets with the halftone negatives and use them to prepare the index to map sheets for the publication of the soil survey. The Center prepares a press ready index when they receive the request for index maps via the National Cartography and Geospatial Center on-line ordering system at http://www.ftw.nrcs.usda.gov/ncgcos. This occurs before completion of the final publication negatives.

(4) Publication Compilation Material.– The National Cartography and Geospatial Center prepares compilation material for publication of the soil survey. Compilation material may include:

(i) Photobase positive–a halftone film reproduction made from the halftone negative. The NCGC punch registers the photobase positive with the halftone negative, using a Hulen punch registration system. When the soil survey boundary coincides with state, county, or national boundaries, the Center draws these boundaries using information from topographic quadrangles. If the limit of the soil survey does not coincide with boundaries on the topographic quadrangles, the ordering office must draft the boundaries on the topographic quadrangles and supply them to the National Cartography and Geospatial Center along with the request for ordering mapping and publication material. The proper location of the soil survey area boundary ensures adequate coverage of the publication material and proper placement of the boundary on the photobase positives. Add join notes and grid coordinate values to the photobase positives as needed.

(ii) Mylar

(iii) Envelopes

(iv) Index to map sheets

(v) Acetate

The National Cartography and Geospatial Center considers the positive, index to map sheets, and envelopes as a complete set of publication compilation materials.

647.03 Compilation.

(a) Memorandum of Understanding

The memorandum of understanding describes who will perform the map compilation, digitizing, and map finishing of the soil survey. This document also identifies the map scale, publication format, the minimum size delineation to be mapped, and the publication due date. If a significant change is made to the work or work area, the originator of the memorandum of understanding prepares an amendment to the memorandum of understanding. See part 606 for more information.

(b) Classification and Correlation Document

The classification and correlation document identifies all approved map information that will appear in the publication. It provides a conversion legend of field map unit symbols to publication symbols; specific instructions for compiling, digitizing, and map finishing; and the Feature and Symbol Legend for Soil Survey (NRCS-SOI-37A, Exhibit 627-5). See part 609 for more information.

(c) Identification Legend

The identification legend consists of map unit symbols and map unit names. Map unit symbols combine alpha, alphanumeric, or numeric characters. Map unit symbols uniquely identify delineations on the map to descriptive and tabular information in the soil survey publication or database. Part 627.04(e)(1) provides development guidelines for the map unit symbols and names. In discussions concerning soil survey map development, the terms "descriptive labels" or "labels" refer to map unit symbols of the identification legend. The term "symbols" in the context of maps refers to specific features in the Feature and Symbol Legend for Soil Survey.

(d) Feature and Symbol Legend for Soil Survey

Each soil survey requires a Feature and Symbol Legend for Soil Survey (NRCS-SOI-37A). See Exhibit 627-5. The Feature and Symbol Legend for Soil Survey (NRCS-SOI-37A) identifies all approved map features that may be published in soil surveys.

Exhibit 627-5 includes the description of standard landform and miscellaneous surface features. The soil mapper describes the ad hoc features and the size of the standard features. Part 627.04 describes the application and development of the legend. The MLRA soil survey office indicates on the NRCS-SOI-37A the features that are to be compiled with a red underline or other obvious indicator. The office submits this marked copy with the final correlation. Compilers only transfer those features that are indicated.

(e) Specifications

Soil survey maps provide information about soils. Cultural and hydrographic information on maps make the soil information more useful. Cultural information on soil survey maps assists the user to establish location. Hydrographic information provides both location and information about the landscape. Although this information combines onto a single map for the published soil survey, it consists of separate themes; culture, hydrography, and soils.

Each map theme may have several types of map features; area, line, or point. Examples of area features include soil areas and water. Examples of line features are streams, gullies, small linear soil delineations, political boundaries, and escarpments. Point features include churches, schools, and most special features, such as wet spots, pits, small point soil delineations, and ad hoc features.

Generally, the base map for field mapping is an aerial photograph or photobase, called a field sheet. The scale within a field sheet may vary because of differences in ground elevation and tip and tilt of the aerial camera. The compilation process, in addition to accurately converting and transferring map information, adjusts for these distortions.

Field sheets are the source for the location and orientation of map features. These features align as shown on form NRCS-SOI-37A in Exhibit 627-5. Most features orient north unless otherwise indicated. The U.S. Geological Survey (USGS) topographic quadrangles serve as guides for locating and identifying some map features. When discrepancies exist between the field sheets and the topographic quadrangles, use the field sheets as they provide the most up to date information. However, a set of topographic quadrangles designated as the *official* set contains all updated information and corrections. If an official set of topographic quadrangles exists, it will be delivered with the compilation materials to the appropriate persons for the map finishing process. The *Instructions for Map Compilation, Map Finishing, and Digitizing* section of the Classification and Correlation document refer to the official set of USGS topographic quadrangles. All cultural and hydrographic features (schools, religious structures, wells, and windmills) are to be drafted by freehand or indicated by codes. The size of the symbols should approximate the size of the symbols shown in Exhibit 627-5, Feature and Symbol Legend for Soil Survey.

Use the following specifications for compiling map information for soil surveys.

(1) Cultural features. Cultural features are administrative and political subdivisions of constructed features. They include boundaries, markers, transportation features, utilities, and various structures. Indicate them on soil survey maps for location purposes.

(i) Boundaries.
- National, State, or Province
- County or Parish
- Minor Civil Division. (only use in Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Rhode Island, and Vermont.)
- Reservations (national or state forest or park) (if desired)
- Limit of the Soil Survey (label) and/or denied access areas
- Field sheet and neatline

(ii) Coordinate grid ticks and values. Place coordinate grid ticks and values during compilation if the compiled information will be used as an interim product of soil survey. Generally placement occurs during map finishing.
- Show coordinate grid ticks and values as UTM meters on all four sides of the map. The values are 1,000 meters for 3.5-minute quadrangle format and 5,000 meters for 7.5-minute quadrangle format intervals. Place so as to lessen any conflict with other marginalia.
- Indicate the latitude and longitude coordinates in degrees, minutes, and seconds at each map corner and at the 2.5-minute tic locations.

(iii) Public land survey system section boundary and corner tics. Generally all States that have public land show public land information. The information includes land division corners or section lines, section numbers, and township and range numbers and division bars. The placement of this information is usually completed during map finishing, however, if compiled information will be used as an interim product, place the information during compilation.
- Indicate township and range identification and division bars along the map neatline.
- Place the section numbers in open spaces as close to the center of the section as possible. Obtain all public land information from the USGS topographic quadrangles or a more current and precise source.

(iv) Transportation features. Compiling roads, trails, and railroads is normally not done because these features show on the published imagery. Use of the appropriate emblems or names for interstate, Federal, state, and county roads is recommended. Place the emblems directly on the feature they represent.

(v) Located Objects. Located objects are optional locational aids.
- Airport and landing field. Label with the proper name, use the term Airport, or place the symbol for the feature.
- Cemetery. Label with the proper name, use Cemetery or Cem, or place the symbol for the feature.
- Church. Only show where it is significant as a locational aid.
- Farmstead. Only show where it is significant as a locational aid.

- Lighthouse. These features are towers or other structures displaying a light for the guidance of mariners
- Located object. Only show this feature in remote areas that have few or no other locational features. Label with a descriptive label.
- Lookout tower. Only show a lookout tower in remote areas that have few or no other locational features.
- Oil or gas well. Oil or gas wells are pits or holes dug or bored into the earth for the extraction of oil or gases.
- Other religion. Other religion refers to sites with religious significance. Do not include the religious denomination in the descriptive label.
- School. Only show where it is significant as a locational aid.
- Sample sites. These may be compiled but not published.
- Tank. Tanks are storage units for water or petroleum. Label as to type.
- Windmill. Show a windmill associated with a well as a windmill, and omit the well symbol. If it is geothermal, do not show it.

(2) Hydrographic Features. Hydrography is information about flowing and standing water. Compile hydrography to conform to the photobase imagery.

Where a hydrographic feature is wide enough that the actual width can be shown, compile the shoreline or each bank as a soil delineation boundary and label with the appropriate map unit label. The shoreline corresponds to the normal stage of water, which is usually marked by a line of permanent land vegetation. The determination of this map unit boundary is a responsibility of the project leader. Areas covered by shallow water may be map unit components that are not water.

Do not label large water areas as Water. Place the proper name inside the feature, if possible; otherwise place it outside. Always use the appropriate map unit label.

The compiler is responsible for drafting any additional bodies of water visible on the photobase map that are not delineated on the field sheets. These delineations are map units and therefore must coincide with the legend, minimum size, requirements, and meet approval of the project leader.

Show a sewage lagoon, industrial waste pond, fish hatchery, or other miscellaneous water area, as a map unit with a map unit label that identifies the area from other water. In addition, use the labels Sewage Disposal Pond, Industrial Waste Pond, or Fish Hatchery.

(i) Drainage end. Drainage ends indicate the direction of flow. Compile the feature where streams end abruptly and disappear into caverns, depressions, marshes, or other areas where the stream is no longer clearly evident.

(ii) Perennial stream. This is a stream that flows throughout most normal years. Compile this solid line feature for a stream that is greater that 0.5 inch in length. Either indicate PSDR or note on the margin that all streams are perennial where not indicated (and then label those that are intermittent as INDR).

(iii) Intermittent stream. This is a stream that is dry for a large part (more than 3 months) of each year. Compile this solid line feature for a stream that is greater than 0.5 inch in length. Indicate INDR or note in the margin that all streams are intermittent (and then label those that are perennial as PSDR).

(iv) Unclassified stream. This is a stream that is not distinguished as either perennial or intermittent. Compile this solid line feature for a stream that is greater than 0.5 inch in length. Label as UCDR.

(v) Perennial drainage or irrigation ditch. This is a perennial drainage or irrigation feature. Compile the solid line with an arrow feature to indicate a feature that is greater than 0.5 inch in length. Label DDIT or note use in the margin.

(vi) Intermittent drainage or irrigation ditch. This is an intermittent drainage or irrigation feature. Compile the solid line with an arrow feature to indicate a feature that is greater than 0.5 inch in length. Label IDIT or note use in the margin.

(vii) Unclassified drainage or irrigation ditch. This is an unclassified drainage or irrigation feature. Compile the solid line with an arrow feature to indicate a feature that is greater than 0.5 inch in length. Label UCDIT or note use in the margin.

(viii) Flood pool line. Some reservoirs require a maximum flood pool boundary. For these reservoirs, compile the soil boundaries and drainage lines to the normal reservoir shoreline. Obtain the location of the flood pool line boundary from the topographic quadrangles, the field sheets, or both.

(ix) Spring. Water seeps or flows from the ground naturally in these places. Only show large and important springs on the soil map in well-watered areas. Because of their vital importance to land use management in arid and semiarid regions, locate and compile springs with great care. These springs usually have names that should appear on the soil map.

(x) Wells. These features are pits or holes dug or bored into the earth for the extraction of water. Artesian wells are deep-bored wells in which water rises under pressure from a permeable stratum overlaid by impermeable rock. Most irrigation wells use pumps rather than gravity flow to extract water. The importance of wells and water tanks depends upon the soil use in the area. Show wells in arid and semiarid regions. They may or may not exhibit surface flow.

(3) Soil survey features. Soil survey features include the delineations of soils or miscellaneous areas, the soil labels, ad hoc features, and standard landform and miscellaneous surface features. Ideally, while mapping, the soil scientist indicates only the features that appear on the legend and will appear in the publication.

Some soil surveys require consolidating map units for correlation reasons, but extent of the map unit should not be one of the reasons. Use standard or ad hoc features for surface located contrasting conditions that affect use and management and that are important for locational purposes. Standard and ad hoc features are not substitutes for describing components of map units.

The soil scientist indicates on the field sheets only the appropriate amount of detail and the features that are necessary for publication. Any detail beyond this clutters the field sheet, may result in incorrect soil information because of compilation decisions, and increases the cost of map preparation and publication.

Compilers maintain registration of field sheet information and the compilation base throughout the soil line transfer process. They adjust the compilation base as the transfer progresses to ensure accurate location of soil area boundaries. Depending on the amount of displacement present in the field sheets, the adjustment may be minor or quite significant. Generally, nominal scale field sheets require much more adjustment during the compilation process than orthophotography used as field sheets.

(i) Soil delineations and soil symbols

- Area soil map unit delineations.

  Soil area boundary lines encircle all soil and miscellaneous areas (including water) that are identified as polygons. Compilers accurately transfer soil area boundary lines from field sheets to stable base media compilation base. They match and extend all feature edges across the neatline of all adjoining sheets to ensure accuracy in the joining.

  After compiling all hydrographic and cultural features onto separate overlays, compilers transfer soil area boundaries onto a third overlay and letter the soil map unit labels that have been approved for publication. They draft all compiled items with sufficient clarity to permit easy and accurate legibility for later interpretation.

All soil area boundary lines will be smooth, solid lines with consistent line width without skips or overlaps. Generally adjust soil area boundary lines to avoid coinciding with other compiled features. Line features that are used to identify soil area boundaries may coincide with hydrography features.

Do not terminate soil area boundary lines on other compiled features, except on neatlines in cases where the neatline is the limit of the soil survey.

In some cases, one publication or approved soil label represents several different soil labels shown on the field sheets. Where this occurs, consolidate adjoining areas of the same label into one soil area. Delete the common soil area boundary line between soil areas combined in this manner. Smooth or round any sharp or irregular delineation resulting from this combining.

- Point or line segment soil map unit delineations.

  Use point or line segment soil map unit delineation features to indicate very significant soil areas that are too small to be shown as soil area features (polygons) at the scale of mapping. Be sure to accurately match the line segment feature to the adjoining map sheet to ensure accuracy in joining.

  The line segment soil map unit delineation feature has precedence over the hydrography feature.

- Other soil survey features.

  Some soil map features are too small to be delineated as areas at a given scale and are represented as either standard landform or miscellaneous surface features or as ad hoc features. These areas are not significant enough to warrant the assignment of a map unit symbol, nor described or interpreted. They generally are observable from the surface. They are locational aids and highlight uncommon occurrences of soil survey features.

  Each standard landform or miscellaneous surface feature has a standard description and symbol. Their size is set in terms of acres by the mapper. Refer to the Descriptions of Standard Landform and Miscellaneous Surface Features and Descriptions for Ad hoc Features on the back of NRCS-SOI-37A Exhibit 627-5.

  In addition, approved marker symbols may be used for special purposes, but their use is not standardized. They have unique definitions and sizes for each soil survey area. These special purpose symbols represent ad hoc features.

  When indicating ad hoc features, use only approved symbols. Use symbols that do not look similar to other symbols used in the legend. The approved symbols for ad hoc features are shown on NRCS-SOI-37A in Exhibit 627-5.

  Compile all symbols for soil survey features to the compilation base in the exact location portrayed on the field sheets. Orient symbols for soil survey features to north.

(ii) Soil labels. Include at least one soil label in each soil area, or attached to each point or line segment soil map unit delineation feature. Use the conversion legend (included in the classification and correlation document) to select the correct soil label when converting field to publication labels. If, during the compilation process, there are labels on the field sheets that are not found on the conversion legend, the project leader will determine the disposition of the symbols. They may need to be added to the legend and final correlation document. Account for every soil label during the correlation process. When making the soil maps in the field, use the correlation process for documenting the disposition of all soil labels. Do not change the soil labels for map units that are combined into other units while the mapping is progressing. Attempting to change the labels rather than correlate them usually results in some labels not being changed. This provides an untimely discovery at compilation of labels that do not appear on the conversion legend.

The MLRA regional office is responsible for the conversion of all labels to either the publication labels or to the legend in the signed classification and correlation document and amendments.

Position soil labels horizontally, space permitting, as near to the center of the delineated area as possible. Where soil areas are large and irregular, place more than one soil label to permit easy identification of the area. Avoid placing soil labels where the publication image is dark, e.g. wooded areas. When an area is too narrow to accommodate a label placed horizontally, place it at an angle or vertically.

Do not allow soil labels to touch or be placed too close to the soil boundary or any other labels. A good rule to follow is to leave a space the width of a soil area boundary line between labels or lines. Place soil labels over streams only if the soil area is long and narrow and space does not permit locating the label horizontally.

Other soil survey features are not labeled, but are accurately located on the map with the appropriate marker symbol.

(iii) Leaders. Only use leaders to connect soil area boundaries to their label when absolutely necessary. If you must use them, do not allow them to cross more than one soil boundary or interfere with any other labels or features. Extend the leader into the soil area so it does not touch the opposite side of the soil area. All point and line segment soil map unit delineation features require a leader to the label.

(f) Coinciding map features

The USGS topographic quadrangles are the source for locating boundaries. However, if any of the boundaries on the topographic quadrangles are out of date or incorrect, indicate the correct location on the field sheets. Also make a notation of the discrepancy in *Instructions for Map Compilation, Map Finishing, and Digitizing* in the classification and correlation document and on the *official* set of USGS topographic quadrangles. Maintain uniformity in line spacing, widths, lengths, and symbolization throughout the map compilation assignment.

(1) When two or more map features fall in the same location on a map sheet, the priority for showing these features are shown in Table 1.

Table 1 Priority for showing coinciding map features

Priority	Feature
1	Road
2	National boundary
3	State boundary
4	County or parish boundary
5	Reservation (national or state forest or park)
6	Limit of soil survey boundary
7	Minor civil division boundary
8	Public Land Survey System Section Boundary
9	Neatline

(2) Features prioritized as 1 through 8 always precede the map neatline. If such situations exist, do not remove the neatline from the compilation base; instead, indicate these features on top of the neatline.

(3) Compile all hydrographic features even if they coincide with prioritized features, removal should only be done during map finishing.

(4) Point or line segment soil map unit delineation features precede hydrographic and other prioritized features. Move soil area boundary lines so that they do not coincide with compiled features.

(g) Lettering

Legibility and consistency of lettering are the most important criteria for making a legible map. Specifying size of lettering is difficult because there are a number of circumstances that make this impractical. The density of soil area boundary lines and the presence of hydrographic and cultural features are some of the items that determine the letter size limitations. Generally, lettering height of soil labels is no less than 0.05 inch nor more than 0.15 inch. The lettering style is simple and legible. Avoid fancy or artistic styles. Use the single stroke, either slant or vertical. It most nearly approaches the strokes ordinarily used in writing, adapts itself to small space, can be photocopied, condensed or expanded without affecting the legibility, and is easy to use.

Freehand letter all names in upper and lowercase. Specific type styles and sizes for hydrographic, hypsographic, and place names are not required on the compilation documents. Use freehand vertical lettering for all features other than transportation and hydrographic features, which are freehand slant lettered. The main requirements are that all lettering be neat, legible, accurate, complete, and consistent.

Unless otherwise specified in the *Instructions for Map Compilation, Map Finishing, and Digitizing* in the classification and correlation document, compile names shown on the field sheets and USGS topographic quadrangles onto the compilation bases. Where discrepancies between the field sheets and topographic quadrangles exist, use the name on the topographic quadrangle. An exception is when, during the mapping process, names or features that are obsolete or incorrect have been crossed out and the corrections indicated in red ink on a set of topographic quadrangles for compilation use. Send this set of corrected topographic quadrangles with the compilation materials for use in the map finishing process.

Position all lettering to read from left to right or from bottom to top of the compilation base. Use the USGS topographic quadrangles for locating features being named. Place all cultural names, road numbers, and soil labels horizontal to the north and south neatlines. Position hydrographic, hypsographic, road, and railroad names in alignment with the features they identify.

(h) Quality Control and Assurance

(1) The MLRA regional office is responsible for compilation and its quality assurance. The MLRA soil survey office, or other office doing compilation, is responsible for a 100 percent edit of the compilation and the MLRA regional office assures the edit with a 10 percent check before its release for digitizing or finishing.

(2) The MLRA soil survey office or compiling office carefully reviews, edits, and properly matches all data (100 percent) from one compilation sheet to another. Exhibit 647-1 provides a compilation edit checklist.

(3) The edit checklist and editorial symbols when used with the overlay provide a useful tool in identifying the most common errors that occur in a given soil survey area. This information can be helpful, to both the soil scientists that performed the mapping or the individual responsible for the compilation, in providing feedback as to where improvements are needed to make a high quality soil map. If the compiler is not a soil scientist, a soil scientist should resolve all soil related errors that are identified during the edit process.

(4) Refer to Exhibit 647-2 for a list identifying common kinds of errors and the recommended editorial symbols indicating the actions needed to correct the errors.

(5) After correcting all edit errors, the MLRA regional office completes the Map Compilation Certification shown in Exhibit 647-3.

647.04 Compilation Techniques.

Request the latest compilation techniques from the National Cartography and Geospatial Center.

647.05 Recompilation for Digitizing.

(a) Planimetric correct base

Digitizing standards require a planimetric correct base. Recompile published soil surveys to a planimetric correct base, typically orthophoto quadrangles, on stable mylar before or during digitizing.

(b) Line adjustment

Use remote sensing techniques that capitalize on the improved base photography, topographic contour features, and stereographic photographs to improve line placement, and thus create a more accurate soil map. Improved placement of a soil delineation results in a slight to significant adjustment from the original soil map in the published report. Reasons for line adjustment are the improved quality of the orthophoto tones, correction of obvious discrepancies between soil delineations and topographic contours, and edge matching.

(c) Documenting changes in line placement

Document changes in line placement and, if needed, provide a supplement of differences from the published soil survey maps to the digitized soil maps. These guidelines also apply to the digitization of parts of soil surveys, such as a local watershed or river basin project.

(d) Minimal Requirements

(1) Memorandum of Understanding. Reference to part 606.01(a)(6) of the National Soil Survey Handbook. Append the existing soil survey memorandum of understanding with amendments concerning the digital product. Those cooperators that signed the original memorandum of understanding are to review and sign the amendment. Address the following items in the amendment.

(i) Purpose - Specify the reason(s) for recompilation before digitizing, such as enacting an exact join, improved photographic tones, more recent photographic image, corrected base, or more suitable scale.

(ii) Cooperating agencies and their responsibilities - Identify the cooperators and define their roles in recompilation and digitizing.

(iii) Specifications and procedures - Explain the procedures to compile and digitize the soil survey or parts thereof. Identify the materials used in the procedures and discuss the general kinds of adjustments that are anticipated in the placement of soil boundary lines. To easily differentiate from the original delineations, specify that line edits will be made to contrast (red ink) with line work of the published soil survey.

(iv) Include the statement - "Maps produced from the new digitized map will be designated the official copy of the soil survey for the NRCS field office technical guide. A record of line edits will be on file for review upon request."

(v) Include the statement - "The soil survey will be digitized according to SSURGO standards and archived at the NRCS National Cartography and Geospatial Center. The digitized soil survey will not be copyrighted and NRCS reserves the right to archive and distribute data generated under the terms of this amendment for their use."

(vi) Identify plans - Identify plans to supplement the published soil survey, or state that no supplement will be issued.

(2) Supplement to a published soil survey map. All supplements will be available to users of soil survey information. The supplement may include the following.

(i) Narrative explanation - Provide a narrative that explains deviations from the published report from digitizing. State in the narrative that "photocopies of edited portions of map sheets are available for review." Statements included in the supplement would be different if soil lines were recompiled to stable base USGS topographic quadrangles rather than orthophotos or orthophoto quarter-quadrangles. See Exhibit 647-4 for a sample narrative explanation.

(ii) Errata sheet - The errata sheet can either be a list of legal descriptions (e.g., Sheet 13, N.W. ¼, Sec. 32) or a thematic map showing the geographic location, to the quarter section or an equivalent, of each edit. An index to map sheets, shaded to depict the areas where changes occur, may be used.

(iii) Edited map sheets for distribution - Edited map sheets that are developed for distribution must be of professional quality. States preference will dictate the kind of map product developed. The National Cartography and Geospatial Center can provide copies of digitized full map sheets with an orthophoto background. Reproductions by the National Cartography and Geospatial Center are on a reimbursable basis. Another option is to provide photocopies of portions of published soil maps showing only where significant changes to line placements have been made.

(3) Classification and correlation document. An amendment to the soil survey classification and correlation document is required if map unit names or symbols, including symbols for ad hoc features, have been converted, added, deleted, or revised. If map units are recorrelated or added, they must be accordance with General Manual, Part 402.5.

(b) Source Materials Required For Digitizing

The following materials and documents should be available at the time of digitizing:

(1) Soil legend - An itemized listing of all soil map symbols and names to be digitized.
(2) Soil map - Soil maps showing cultural features, hydrographic features, soil area boundaries, point and line segment soil map unit delineations, soil map unit labels, standard features, and ad hoc features.
(3) Map indexes - An index to soil maps and USGS topographic quadrangles or orthophoto quadrangles.
(4) Published soil survey maps - Copies of the original published soil survey maps.
(5) Soil classification and correlation document and amendments - An approved document is required before a soil survey is contracted for digitizing.

647.06 SSURGO Characteristics.

The SSURGO database is:

(a) Defined in a memorandum of understanding.
(b) Mapping on hard copy aerial photography, subsequently compiling to orthophotography, and hand- or scan- digitizing are avoided if at all possible. Field mapping is done using electronic media and on-screen digitizing as much as possible to avoid these extra steps.
(c) If (b) above is not possible, map on orthophoto 7.5 minute quadrangles or orthophoto 3.5 minute quadrangles or compile onto one of these bases before or during digitizing. USGS 7.5-minute topographic quadrangles or SPOT quadrangles may also be used if orthophoto quadrangles are not available.
(d) Mapped at scales ranging from 1:12,000 to 1:63,360.
(e) Supported by an approved and signed classification and correlation document and amendments.
(f) Digitized by raster scanning and vector conversion or line-segment (vector) methods.
(g) Captured or converted to a Geographiccoordinate reference system, decimal degrees map units, and a North American Datum of 1983 with a Geodetic Reference System of 1980 spheroid or a North American Datum of 1927 with a Clarke 1866 spheroid.
(h) Geo-referenced digital spatial data, tabular data, and metadata.
(i) Spatial data stored in a vector data structure.
(j) Archived in a seamless survey area.
(k) Within digitizing standards and specifications of NRCS.

647.07 Digitizing Specifications.

(a) Base Map Characteristics

The soil survey base map must meet the following characteristics.

(1) **Maps to be used.** Base maps used for digitizing soil surveys must meet National Map Accuracy Standards. 7.5-minute orthophoto quadrangles, 3.75-minute orthophoto quadrangles, USGS 7.5-minute topographic quadrangles or SPOT quadrangles meet these standards. Base maps produced from digital orthophotography to the National Standard for Spatial Data Accuracy are also acceptable. Base maps are to be on stable material to minimize distortion caused by contracting and expanding from changes in temperature and humidity. Mylar material that is 0.004-inch (4 mil) thick is suitable under normal stable environmental conditions. Generally humidity fluctuations affect mylar stability more than temperature fluctuations.

Soil surveys not mapped on a base that meets map accuracy standards are recompiled onto an accurate base map before or during digitizing. If the soil survey is mapped on an accurate mylar base map, only the accurate conversion of soil map unit symbols and standard and ad hoc features to those on the publication legend is necessary. If the soil survey is mapped on rectified aerial photography, the accurate transfer of boundaries onto one of these base maps is necessary to correct for ground relief distortion before or during digitizing. The use of 1:12,000 or 1:24,000 digital orthophotography is strongly encouraged.

(2) **National Standard for Spatial Data Accuracy**. These standards define spatial accuracy as it pertains to map products at scales of 1:250,000 and larger produced by Federal agencies. They supersede the National Map Accuracy Standards issued June 10, 1941, and most recently revised on June 17, 1947, by the former U.S. Bureau of the Budget.

These standards are the measure of positional accuracy of map features (the difference between their map position and where they actually occur on the ground). Soil surveys will be digitized only from base maps that meet these standards.

(i) Horizontal Accuracy - The standard error, or root-mean-square error, is measured separately in both the x and y coordinates at the publication scale (Table 2).

- For Class 1 maps, the standard error shall not exceed ± 0.25 mm.
- For Class 2 maps, the standard error shall not exceed ± 0.50 mm.
- Maps that exceed ± 0.50 mm do not meet National Standard for Spatial Data Accuracy.

Table 2. Horizontal accuracy limits at ground-scale.

Scale	**Limits for x or y meters (ft)**	
	Class 1	**Class 2**
1:12,000	±3.0m (10)	±6.0m (20)
1:24,000	±6.0m (20)	±12.0m (39)
1:63,360	±15.8m (52)	±31.6m (104)

(ii) Vertical accuracy - The following limits of accuracy apply to contour maps and to maps showing spot elevations.

- For Class 1 maps, the standard error of elevations determined from the contours shall not exceed one-third of the contour interval.
- For Class 2 maps, the standard error shall not exceed two-thirds of the contour interval.
- Maps with elevations that exceed the Class 2 criterion do not meet National Standard for Spatial Data Accuracy.
- The standard error for spot elevations (heights) shall not exceed one-sixth of the published or planned contour interval.

(iii) Accuracy Test - The allowable limits are expressed in millimeters at the product scale, rather than ground scale.

- Certification of products shall be based on both horizontal and vertical tests, unless contours or spot elevations are not shown, in which case certification shall be based only on horizontal tests.
- All map measurements will be made on stable base materials.
- The horizontal and vertical accuracy tests shall each have a minimum of 20 and not more than 50 well-defined test points, well spaced and spread over the project as evenly as is economically possible.
- Maps in which the vertical or horizontal standards are impractical to meet are considered to fail standards for that dimension of the standards not tested.
- When testing a sufficient number of maps (3%) in a series is impractical to determine whether the series as a whole passes or fails, then all maps in the series shall be labeled as not tested.
- Compute standard errors by comparing the positions or elevations of points with corresponding positions or elevations as determined by surveys of a higher accuracy.
- Calculate the standard error separately for the x and y coordinates and for vertical test points using all the test points.

- Determination may be made without a formal test when the product is derived using larger scale products or products known to meet these standards, or by error propagation analysis that clearly proves conformance.
- The limits of accuracy apply in all cases to positions of well-defined points. Well-defined points are features, such as road intersections or road and railway intersections that can be accurately identified and located at discrete positions.

(iv) Product Identification - Label products with a two-part label; if elevation information is not shown, label products for horizontal accuracy only.

- If both horizontal and vertical pass, label:
- "Complies with National Standard for Spatial Data Accuracy (Horizontal), Class __"
- "Complies with National Standard for Spatial Data Accuracy (Vertical), Class __"
- If either or both are tested, but fail, replace appropriate line or lines as shown below. Insert Horizontal, Vertical, or Horizontal and Vertical as appropriate.
- "Does not meet National Standard for Spatial Data Accuracy (______)"
- If either or both are not tested, replace appropriate line or lines as shown below. Insert Horizontal, Vertical, or Horizontal and Vertical as appropriate.

  "Not tested for Compliance with National Standard for Spatial Data Accuracy (______)"

(v) Series Maps - At least 100 maps are made using similar source material, instruments, and procedures.

- The class of a series of maps may be determined by testing a limited number of individual maps from the series.
- At least 3 percent (but not less than 10) individual maps must be tested.
- The class into which 90 percent of the standard errors of the individually tested maps fall will apply to the entire series.

(3) Reference System. The horizontal control for the SSURGO database is the North American Datum of 1983 or the North American Datum of 1927 and is determined by the compilation base.

(4) Map Sheet Formats. Soil surveys mapped on the ½ or 1/3 orthophoto quadrangle formats can be digitized in these formats; however, soil digital data sets provided to the NRCS must be merged and formatted in a 7.5-minute quadrangle format. Soil surveys mapped on 3.75-minute orthophoto quadrangles do not need to be merged into a 7.5-minute quadrangle format. The map base for the final product of all soil surveys will be on orthophoto quadrangles at a standard map scale of either 1:12,000 or 1:24,000.

(b) Features To Be Digitized

Area soil survey features and linear and point soil survey features are digitized as three separate layers.

(1) Layer 1

(i) Examples of area features are soil and water areas. These features are composed of soil boundary lines or other boundary lines such as a double line stream or limit of soil survey that form polygons and occupy area.

(2) Layer 2

(i) Examples of soil line segments are narrow elongated riparian areas.
(ii) Examples of soil point features are small circular riparian areas.

(3) Layer 3

(i) Examples of special linear features are escarpments and gullies.

(ii) Examples of special point features are landform features, miscellaneous surface features, and ad hoc features sometimes known as spot symbols. Wet spots, pits, and sinkholes are specific examples of these features.

Both linear and point special features represent areas that are too small to be digitized as polygons (area features smaller than 0.5 cm in diameter).

(c) Data Capture

The following standards and specifications apply to digitizing soil surveys at scales from 1:12,000 to 1:63,360.

(1) Soil nd Water Boundaries.

(i) Digitize each soil or water boundary within a 0.01-inch (0.254 mm) line width of the source document. Follow the centerline of the boundary. Represent each boundary with no greater number of coordinate pair vertices, than is necessary to record the boundaries within the 0.01-inch (0.254 mm) accuracy limit.

Digitize "islands" as a continuous line segment with only a beginning and ending node.

Connect beginning and ending points of each digitized line at a common intersecting point with another soil boundary, water boundary, or limit of soil survey boundary.

(2) **Limit Of Soil Survey**. Digitize each soil survey area boundary within a 0.01-inch (0.254 mm) line width of the source document. Follow the centerline of the boundary. Represent each boundary with no greater number of coordinate pairs, vertices, than is necessary to record the boundary within the 0.01-inch (0.254 mm) accuracy limit.

(3) **Geographic Control**. Establish geographic control using the four corner coordinate values of the 7.5-minute topographic quadrangle, 7.5-minute orthophoto quadrangle, or 3.75-minute orthophoto quadrangle.

(4) **Nodes**. Digitize nodes at the intersection of soil lines and at the endpoint of lines where they join.

(5) **Linear Features**. Digitize linear features as a single line within a 0.01-inch (0.254 mm) line width of the source document.

(6) **Point Features**. Digitize point features as a single coordinate pair within a 0.01-inch (0.254 mm) distance of its location on the source document.

(d) Legends

(1) Area Features

(i) The soil map symbols in the legend in the classification and correlation document and amendments.

(ii) Permanent water and miscellaneous water will conform to soil map unit labels (i.e., alpha, numeric, or alphanumeric)..

Table 3 shows an example of an approved correlation legend.

Table 3. An approved correlation legend

ApB	Alpha silt loam, 1 to 3 percent slopes
Ba	Barney loam, very stony
Be	Beta silt loam
Go	Gomer clay, frequently flooded
Md	Madras loamy fine sand
W	Water
We	Wehadkee fine sandy loam

(2) Point and Line Segment Soil Map Unit Features

The soil map symbols in the legend in the classification and correlation documents and amendments.

(3) **Linear and Point Special Features.** Digitize the soil survey standard and ad hoc features identified in Exhibit 627-5, NRCS-SOI-37A Feature and Symbol Legend for Soil Survey if they are identified in the classification and correlation document and amendments. Table 4 shows an approved feature and symbol Legend. Ad hoc features follow standard landform and miscellaneous surface features on the legend. Part 647.08 describes how to assign labels to the ad hoc feature.

Attribute the features with the descriptive labels during data capture.

Table 4. An approved soil survey features correlation legend

CLA	Clay spot
GPI	Gravel pit
ROC	Rock outcrop
SLP	Short, steep slope
STV	Very stony spot
WET	Wet spot
BOG	Areas of acid organics

(e) **Labeling**

(1) **Descriptive Labels**. Label each polygon with a descriptive label. The descriptive labels are identical to the map unit symbols in the approved soil classification and correlation document and amendments. This includes symbols for map unit delineations, standard features, and ad hoc features.

(2) **Label Position**. Position the coordinate point for the map unit label at or near the centroid of the polygon. Move the coordinate point into the area if the centroid falls outside of the polygon. Centrally locate the coordinate point for linear and point features on the feature.

(3) **Special Labels**. Special labels are assigned during digitizing to areas that were not compiled with map unit labels. If they are assigned, they should be added to the classification and correlation document. Special labels are listed in the mapunit table in NASIS so that a mukey can be generated for them. As such, they will be included in the map unit legend legend.

(i) Label areas not yet mapped or digitized as part of a progressive survey **NOTCOM**, for not completed.

(ii) Label areas outside the limit of the soil survey area boundary, but within the neatline **BLANK.**

(iii) Label large concrete or riprap covered dams **DAM** and large levees **LEVEE** when unassigned.

(iv) Label water areas (ponds, lakes) with the symbol that has been assigned. If the areas are not assigned, label the water area as **W** or **M-W** if a miscellaneous water area.

(v) Label map features crossing into adjacent map sheets with the same descriptive labels.

(vi) Label areas **DA** that are unmapped because of denied access.

(vii) If the map unit symbols are numeric, then the symbols are assigned numeric values except BLANK and NOTCOM.

(f) **Spatial Data Format**

(1) **Spatial Format**. Digital soil data sets are in a seamless survey area format.

(2) **Internal Spatial Reference**. Coordinate values can be collected in any internal coordinate system during the digitizing process.

(3) **External Spatial Reference.** The following coordinate reference system is required for all coordinate data;

(i) Ground based system and projection are Geographic.

(ii) Map units are in decimal degrees.
(iii) An ArcInfo coverage is the format imported into the Soil Data Warehouse.Horizontal datum is the North American Datum of 1983 that is based upon the Geodetic Reference System of 1980 spheroid or the North American Datum of 1927 that is based upon the Clarke 1866 spheroid. The reference system is the same as the digitizing base.
(iv) No x_ or y_ coordinate shifts (offsets) are permitted.
(v) Format of data coordinates is real.

(4) Data Structure. Map data are in a vector structure (i.e., location of lines, points, and area boundaries are represented as strings of x, y coordinate pairs).

(g) Spatial Data Files Naming Convention

(1) The naming convention for SSURGO spatial files is the 2-letter state abbreviation followed by the FIPS code. Each geospatial layer has its own designation.
(2) a – soil polygon coverage
(3) b – soil survey boundary coverage
(4) c – linear soil map unit coverage
(5) d – point soil map unit coverage
(6) l – linear special feature coverage
(7) p – point special feature coverage
(8) q – quadrangle coverage

An example of the soil polygon coverage name for Henry County, Virginia is VA089_a.

(h) Tabular Attribute Data

The MLRA regional office certifies the tabular attribute data to be current and accurate. Current and accurate data are current with the soil classification and correlation document and amendments, and they are identical to the data downloaded for use in the Field Office Technical Guide. The reliability of the individual data elements and tables are to be addressed in the metadata file if necessary.

The exportcertdate column in the distlegendmd Map Unit Record table is defined as the mm/dd/yyyy the data for the soil survey area was certified by the MLRA regional office as edited and available for public use. This column must be populated when submitting the tabular data. This is essential for dating the tabular data, which are periodically updated.

(1) Map Unit Record Database. Each map unit symbol contained in the spatial data must have a matching symbol in NASIS. It is acceptable for extra symbols to be in the NASIS data that are not in the spatial data.

(2) Soil survey features. Prepare and archive a soil survey features file for the SSURGO database. The name of the file will be "feature." The format is a variable record length ASCII text file. The first row contains the name of each column, feat_label, feat_name, and feat_desc. The second row contains at least one dash underneath each column name. Tabs separate the column names and dashes. A return character is at the end of each of these rows. Delimit each subsequent row by a return character and form a record in the table. A row consists of tab delimited columns. Each row has the same number of columns as the file header (first two rows). The file contains a descriptive label, feature name, and definition for each linear and point soil survey feature and ad hoc feature in the legend.

(i) Metadata

The Soil Survey Geographic (SSURGO) product is a combination of both spatial and tabular data. Federal Geographic Data Committee compliant metadata exists for the spatial and tabular data. Both static and dynamic metadata exist for the tabular component.

Metadata provide information about the content, quality, condition, and related characteristics of data. Metadata provide information about the NRCS Soil Survey Geographic (SSURGO) database holdings to data catalogues, clearinghouses, and brokerages. They also provide information needed to process and interpret SSURGO data received through a transfer either by media or Internet. Metadata provide information needed to:

- Determine the sets of data that exist for a geographic location.
- Determine if a set of data meet a specific need.
- Acquire an identified set of data.
- Process and use a set of data.

(1) Submit metadata with the SSURGO spatial for archiving in the Soil Data Warehouse. The template in Exhibit 647-13 is used to create metadata. The template and explanation of numbered blanks are available in an ASCII digital format from the National Cartography and Geospatial Center. The name of the metadata file in the SSURGO database is the area symbol for the soil survey area to which the dataset applies. The extension will be ".met". For example, va001.met, is the name of the metadata file for Accomack County, Virginia.

(2) SSURGO Version 2 Static Tabular Metadata. The dynamic metadata documents the contents of a particular export. The reports and diagrams listed below document the static tabular metadata, which includes documentation of the tables that ultimately record the dynamic tabular metadata. The following reports and diagrams are available in Adobe Portable Document Format at http://nasis.nrcs.usda.gov/documents/metadata/ssurgov2_0/

(i) Static Tabular Metadata - Domains
(ii) Static Tabular Metadata - Tables
(iii) Static Tabular Metadata - Table Columns
(iv) Static Tabular Metadata - Table Column Descriptions
(v) Static Tabular Metadata - Indexes
(vi) Static Tabular Metadata - Relationships
(vii) Traditional Data Structure Diagram
(viii) Physical Data Model
(ix) SSURGO Version 2 Microsoft Access Template Database for Microsoft Access 97 (zipped)
(x) SSURGO Version 2 Microsoft Access Template Database for Microsoft Access 2000 (zipped)

(j) Quality Control

Quality control of soil surveys and their digitized products is the responsibility of the office doing the work. The MLRA regional office provides quality assurance. The MLRA regional office ensures that the digitizing source document is correct and that the digitized data match the digitizing source.

The digitizing unit performs a 100 percent edit of all materials. This includes a 100 percent hardcopy check plot review. The digitizing unit submits materials to the MLRA regional office during the course of the work. The MLRA regional office provides a 100 percent review of 10 percent of the digitized material. The MLRA regional office does not provide final approval until approval by progressive correlation or by a final classification and correlation document.

(1) **Editing**. A complete and detailed edit of the digitized data (100% edit by digitizing unit) occurs before their release for negative preparation or for submission into the SSURGO database.

(2) **Check Plots**. Each digitized quadrangle of a soil map data set requires a computer generated mylar check plot. The digitizing units produce the check plots. The check plots are to check line and label accuracy with the source maps. The digitizing unit conducts this 100 percent edit. MLRA regional office supervises or ensures this edit. Check plots require the following (the color used for the plots are optional, they should be a different color than the compilation documents):

(i) Generate an ink check plot for each quadrangle with a 0.01-inch (0.254 mm) line width on stable base mylar (minimum of 4 mil) material. Plot all data within 0.005 inch (0.127 mm) of their coordinate locations in the database.
(ii) Plot descriptive labels horizontally as single stroke characters with a height and width of 0.08 to 0.1 inch (2.032 mm to 2.54 mm).
(iii) Plot the map name and scale outside of the map neatline.
(iv) Plot area features and linear and point features either on a single plot or on separate plots.
(v) Plot area feature boundaries, neatlines, limit of soil survey boundaries, and descriptive labels and other text in black.
(vi) Plot the origin points for point features 0.03 (0.762 mm) in diameter. Plot the origin points and their abbreviated descriptive labels in green. Offset the label from the original point such that the label does not touch the origin point. Use the lower left corner of the first character of the descriptive label as the point of text origin.
(vii) Plot linear features and their abbreviated descriptive labels in green. Locate the label point at the center of the line feature. Offset the label from the label point such that the label does not touch the feature. Use the lower left corner of the first character of the descriptive label as the point of text origin.
(viii) Position the descriptive labels within the soil area so they begin within the soil area. The descriptive labels for area features are identical to the soil map symbols shown on the compiled/recompiled soil map. Use the lower left corner of the first character of the descriptive label as the point of text origin.
(ix) Plot unidentifiable feature labels as XXX in red until resolved.
(x) Plot the maps at the same scale and projection as the original digitized maps.
(xi) Plot a second set of maps at the 1:24,000 (or 1:12,000) scale if the original map scale is other than 1:24,000 (or 1:12,000). This is done after the final digitized data are accepted.

(3) Statistics. Generate statistics for each quadrangle in the soil survey area and for the survey area. Generate the acreage statistics by UTM projection. In addition to quality control, acreage statistics replace the grid dot counts or planimetered acreage normally performed. Do not submit these statistics as a part of SSURGO. Note the discrepancies of more than 10 percent of the total between the Natural Resource Inventory (NRI) total and spatially determined totals in the SSURGO review. The state soil scientist and MLRA regional office leader review and decide where adjustments to individual map unit totals are needed.

Maintain and document the digitized acreage summary as "Digitized SSURGO Acreage Summary" when distributed. Adjust the digitized acreages for the Bureau of Census water and land totals for publication. Document as "Census Acreage Summary" when distributed. The main difference between the two acreage summaries is the water acreage. Census water includes only water areas greater than 40 acres, and the digitized SSURGO acreage summary includes all water. Water, a miscellaneous area, can be phased to meet the needs of the soil survey. also broken down into permanent water (lakes, ponds, reservoirs) and miscellaneous water (sewage lagoons, holding ponds, fish hatcheries).

(i) Quadrangle – As needed or requested by the State Soil Scientist or MLRA regional office, generate acreage calculations and a total polygon (area) count for each 7.5-minute quadrangle or 3.75-minute quadrangle area feature map. Sort acreage calculations, to the nearest acre, by descriptive labels.

(ii) Summary - Summarize acreage data and polygon counts by descriptive labels for all 7.5-minute quadrangles or 3.75-minute quadrangles. Use the format shown in Table 5.

Table 5. Acreage calculation and polygon count for a quadrangle

NOTCOM	798
BLANK	2280
ApB	1082
Ba	1920
Be	267
Go	2287
Md	115
W	101
We	198
Total acres	9048
Total polygons	165

(k) Quality Assurance

The MLRA regional office is responsible for the overall technical accuracy of soil surveys.

The National Cartography and Geospatial Center provides assistance to the MLRA regional office on quality assurance review of digitized soil surveys.

647.08 Attributing Linear and Point Soil Features.

(a) Definition

Linear and point soil delineation features are soil spatial areas that are too small to delineate at the mapping scale, but are large enough and contrasting enough to significantly influence use and management.

(b) Legend Development

Use a leader to attach the symbols for point and line segment map unit delineations to the point or line segment. Correlate these symbols or labels into the soil survey area legend and handle like other map units.

(c) Digitizing

For the SSURGO database, digitize all linear and point features that are mapped and correlated.

647.09 Digital Map Finishing.

(a) General

The memorandum of understanding describes who will perform map finishing. The NRCS-SOI-37A (Exhibit 627-5) in the Classification and Correlation document identifies features to appear in the soil survey publication. Only map finish the items indicated on this approved NRCS-SOI-37A. Omission of features on the compilation does not constitute the omission of features on the map finished maps. The MLRA regional office decides the fate of questionable compilation map features. The MLRA regional office has responsibility for developing, archiving, and maintaining text layers for soil survey publication maps. The National Cartography and Geospatial Center archives the certified SSURGO data.

(b) Quality Control and Assurance

The MLRA regional office is responsible for map finishing and its quality control and assurance. This office is responsible for ensuring a 100 percent edit of the map finishing before the final negative preparation. The digital map finishing site is responsible for carrying out the 100 percent edit and the MLRA normally conducts a 10 percent spot check. State offices upon agreement may share this role. A map finishing edit checklist is provided in Exhibit 647-10. If the review is satisfactory, the MLRA Leader signs the map finishing certification letter and ships the materials to the National Cartography and Geospatial Center. Refer to Exhibit 647-11 Map Finishing Certification for a certification letter example.

The National Cartography and Geospatial Center provides quality review assistance to the MLRA regional office. After the MLRA regional office approves the map finished materials, they ship them to the center for final negative preparation.

Prior to preparing the negatives, the National Cartography and Geospatial Center selects at random, a ten percent sample of the maps. They plot the selected map files and review them for data format conformity and data accuracy. If the review indicates that the data files are acceptable, they prepare the data as negatives.

If the review indicates that the data are not acceptable in the provided format, they return the materials to the MLRA regional office. The MLRA regional office corrects all deficiencies before submitting the materials for an additional sample review by the National Cartography and Geospatial Center.

Materials

(1) Compilation materials including the photobase maps and compilation overlays
(2) Index to maps
(3) Composite check plots for each quadrangle or quarter-quadrangle map
(4) Signed SSURGO certification (Exhibit 647-5) and map finishing certification (Exhibit 647-10) documents
(5) Signed classification and correlation document and amendments with new NRCS-SOI-37A
(6) Postscript files of all publication maps on an 8 mm tape

(c) Specifications

Base map requirements for digital map finishing are the same as those for SSURGO digitizing. Part 647.07(a) (1) has additional information. Generally MLRA regional offices digitize and certify as SSURGO all surveys that are compiled to orthophotography prior to digitizing for map finishing. Soil surveys mapped and compiled in the 1/3 quadrangle format can be digitized in this format; however, digital data sets provided to and archived by the NRCS must be merged and formatted in a full 7.5-minute quadrangle. Soil surveys mapped on 3.75-minute orthophoto quadrangles do not need to be merged into a 7.5-minute quadrangle format.

Develop data layers for the soil data theme and optionally for the culture and hydrography themes, as determined by the State Soil Scientist and Memorandum of Understanding. Format these layers for archiving in modified DLG-3 optional format. Digitize data features as points, lines, or areas. Exhibit 647-13, DLG major and minor codes for soil survey publication features, defines the descriptive label, major and minor codes for all cultural and hydrographic features. Derive the soil data from the certified SSURGO data. Develop text files containing additional soil labels. Give consideration for the best placement and for the number of labels needed for each soil area. Develop text files with proper names for cultural, hydrographic, and hypsographic features in agency supported software.

For each published map, combine and process the data layers into two plot files in Postscript format. One plot file contains all data to be published in blue, the other plot file contains the data to be published in black. All work must meet the proper density, line widths, symbol, font styles, and sizes as listed in Exhibit 647-7, Symbol and Font Specifications. Register all work to the photobase image.

(d) Data Files

Develop up to four data files for each soil survey publication map. The cultural data theme embeds the public land survey. One file of this theme contains only the public land survey section corners and section labels and another file contains all other cultural features. The files are named with the .pf and .cf extensions respectively. Non-public land survey areas only have one cultural data file. Develop one data file named with the .hf extension for all hydrographic features. Two data files may exist for the soil theme. One required file is the soil area file with the .af extension. A special feature file named with the .sf extension may exist.

(1) Culture. Cultural information including political and administrative boundaries, transportation, buildings, structures, and public land survey are black on the publication maps.

When two or more boundaries fall in the same location, the Table 6 shows the priority for digitizing these features:

Table 6 Priority for showing coinciding map features

Priority	Feature
1	Road
2	National
3	State
4	County or parish
5	Reservation (National or state forest or park)
6	Limit of soil survey
7	Minor civil division
8	Public Land Survey System Section
9	Neatline

(2) Hydrography. Hydrographic information includes streams, drainage and irrigation ditches, flood pool boundaries, springs, and wells. Streams less than 0.5 inch in length are not shown except those connected to neatlines that extend onto the adjacent map. All hydrographic features as represented in the "Hydrographic Features" column in the "Feature and Symbol Legend for Soil Survey" are represented in blue on publication maps and are printed on a separate negative. Water bodies, while of hydrographic origin, are represented on a negative containing all other soil survey information shown in black.

(3) Soils. Soil information includes the soil delineations, soil labels, standard landform and miscellaneous surface features, and ad hoc features certified as SSURGO. Use a copy of the certified data to ensure that all soil information is complete and accurate. Soil delineations include all linear and point soil delineations as well as soil and miscellaneous areas such as gravel pit areas, water areas, miscellaneous water areas which are further identified as sewage lagoons and filtration ponds, and double line streams and canals.

Soil area boundaries must match adjoining maps and never are broken or interrupted for any other feature. All soil survey features are black on the publication maps.

(e) Text

Text includes proper names of cultural, hydrographic, and hypsographic features indicated on published soil surveys. It also includes marginalia describing map parameters and source notes, and soil labels.

Use the USGS 7.5-minute series topographic quadrangles as guides for determining the names and locations of all text excluding the placement of soil labels. Position all lettering so that the wording is read from left to right or from the bottom to the top of the map. Align text with the general shape of the feature it represents, unless specified to be placed horizontally. When letter spacing is required for effective presentation of feature names, display the text with the letters proportionately spaced across the area to be identified. Repeat text on adjacent maps with consistent letter spacing and size. Avoid placing text over other features whenever possible.

(1) Marginalia. All marginal information must be within 0.5 inch of the image area. The image area may not exceed 25 inches (width) by 29 inches (height). Show marginal map information for each map and include:

(i) agency name. Locate the agency name in the upper left corner of each map, 0.75 inch above the map neatline and 1 inch from the map margin, in 12 point, Century condensed. Indicate as:

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

(ii) soil survey area title. Locate the soil survey area name in the upper right corner of each map, ¾ of an inch above the map neatline and 1 3/8 inch below the map margin, in 12 pt, Times.

(iii) quadrangle name. Indicate the USGS quadrangle name in the upper right corner of each map, below the soil survey area name in 12 pt, Times.

(iv) soil survey publication sheet number. Indicate the map sheet number on the line below the quadrangle name in 12 pt, Times.

(v) USGS map series. Indicate the USGS map series below the soil survey publication sheet number in 8 pt, Triumvirate. It is either 3.75-MINUTE SERIES or 7.5-MINUTE SERIES.

(vi) bar scale. Indicate three separate bar in the lower center of each map. Position the first, representing the one kilometer increment, 1 inch below the map neatline. Position a second bar scale, representing 1000 foot increments, up to 7000, 0.5 inch below the first scale. Position a third bar scale, representing a mile increment, 0.5 inch below the foot bar scale.

(vii) map projection information. Indicate map projection parameters to the left of the bar scale and map scale information in the lower center of each map. They include the UTM coordinate system and zone, Polyconic projection, and datum. A survey area may fall within more than one UTM zone. The information requires the appropriate zone for each quadrangle. The datum may be either 1927 or 1983 North America Datum. The datum is the same for all maps within a survey area. Indicate all map projection information in 8 pt, Triumvirate.

(viii) source note. Each map requires a source note on the lower left corner of each map in 8 pt, Triumvirate. It references contributors to the soil survey program and identifies the imagery date. Modify it for each survey area but at a minimum include the following:

This soil survey map was compiled by the U.S. Department of Agriculture, Natural Resources Conservation Service, formerly Soil Conservation Service, and cooperating agencies. Base maps are orthophotographs prepared by the U.S. Department of Interior, Geological Survey, from _____(year) aerial photography.

Coordinate ticks and land division corners, if shown, are approximately positioned. Digital data are available for this quadrangle.

(ix) Join notes. Indicate join notes identifying the adjacent sheet number and quadrangle name at the center of each of the map neatlines, 7/8 of an inch from the map neatline, for each map in 8 pt, Univers and in parenthesis. Orient join notes on the western and eastern sides of maps to read from bottom to top. Use the index to map sheets to determine the adjoining sheet numbers for all maps.

(x) State coordinate ticks and values. State coordinate ticks and values are optional features. If shown, the preferred system is Universal Transverse Mercator (UTM) meters. Indicate these tick values in one thousand meter increments in 6 pt, Univers medium along the margin. Delete them if the values coincide with other margin information. Always orient the values horizontally.

(xi) Geographic coordinate ticks and values. Indicate the geographic coordinate values as latitude and longitude in 8 pt, Univers medium at each map corner. The values are either the full 7.5-minute corner values or the 3.75-minute values. In addition, for full quadrangle format maps indicate the coordinate values representing the 2.5-minute ticks.

(xii) North arrow. Indicate a north arrow in the lower left center of each map, positioned approximately 1 inch below the map neatline and 1 inch to the left of the neatline corner. It is 1 inch in length with the arrow portion 0.10-inch length. Indicate the "North" in 6 pt, Truimvirate condensed.

(xiii) Land division township and range identifications and division bars. Indicate township and range identifications on all surveys that contain these survey divisions. Indicate the values in 8 pt, Univers medium.

(2) Boundary identifications

(i) Political Boundaries. Identify all national, state, county, or parish boundaries in 8 point Century Schoolbook Caps placed parallel to the boundary line.

- For surveys that coincide with counties, show the names of adjacent counties along the outside edge of the soil survey boundary parallel to the boundary. Where the survey joins another state, show the adjacent state name along with the adjacent county names. Where the survey adjoins another nation, show the national name and its provincial name along the national boundary. If a boundary spur occurs along the map edge, show the adjacent names approximately 0.5 inch from the boundary spurs.
- For survey areas that contain more than one county or portions of counties and have county (or state) boundaries within a survey area, show the names of counties and states as they occur on each side of the state boundaries. Show the names more than once on maps where the boundaries are meandering and difficult to follow.
- Position county names with approximately a 0.30-inch space between word components and approximately 0.50-inch spacing between the county name and state name word components. Lengthen or shorten the spacing to avoid overprinting of marginalia.
- Some maps in some states require minor civil divisions and administrative subdivisions of counties. The following states require minor civil division boundaries and names on soil survey maps: Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Rhode Island, and Vermont.
- Show the minor civil division names widely letter spaced, horizontal in placement, and centrally located within the bounded areas. They may be placed vertically only in areas with long vertical dimensions. Standard type size and style is 12 point Century Schoolbook Caps.
- Where a minor civil division extends throughout the entire map, place its name near the center, allowing clearance for other lettering and line work detail. Average spacing between letters should be about 1.25 inches for short names and about 0.75 inch for longer names. Select an equal spacing interval between letters, which will allow placement without overprinting.
- Where towns or cities are also minor civil divisions with different proper names, show the official minor civil division name in letter spaced News Gothic and the place name in Spartan Heavy. Small areas of minor civil divisions occurring on adjacent maps that can

not accommodate both the place name and the minor civil division name should show only the place name.

- If an adjoining minor civil division is the same name as the town or city minor civil division, omit the name within the town or city minor civil division. Show only the place name in Century Schoolbook. The exception is when the imagery of a town does not encompass the complete minor civil division limit and large areas of open land are evident. Then show both the minor civil division and place name.

(ii) Administrative boundaries. Letter the names of national or state parks, forests, and reservations in 12 point Century Schoolbook Caps. These names are usually letter spaced and placed horizontally to neatline. Use the maximum 12 point size when the features occur over several maps. Set their name components on separate lines and space apart to suggest the extent of their areas.

(iii) Soil survey boundaries. Show all boundary identifications in 6 pt, Univers Condensed. Do not show boundary identifications haphazardly on either side of the boundary line. Locate the identifications within the area being identified in open map spaces where possible. The exception to this rule is the limit of the soil survey boundary. Label boundaries at least one time per map and parallel to the boundary alignment.

- If the proper name of a reservation, forest, or national or state park does not appear in the interior of the map, identify the boundary with its proper name, such as "ROSEBUD INDIAN RESERVATION BOUNDARY".
- Identify limit of soil survey boundaries only when they do not correspond with national, state or county identified reservation boundaries. Label them "LIMIT OF SOIL SURVEY".
- Occasionally, certain boundaries that follow along meandering streams or in rugged terrain are not positively located on topographic quadrangles or other source material. This is most often because of boundary disputes or lack of modern cadastral survey establishing the boundaries. Label these boundaries "INDEFINITE BOUNDARY".
- Some boundaries are positively located on the landscape, but because of inadequate source material, label the boundaries "APPROXIMATE BOUNDARY". This is particularly applicable to minor civil division boundaries in rapidly urbanizing areas. Many of these boundaries change faster than available source materials can be updated.

(iv) Land Division. Identify all land division sections or tract numbers, if mapped, within the interior of all maps. Use 12 point Univers and place section numbers in open spaces near centers of full sections. On maps containing half sections or less, place the section numbers horizontally near the center of the partial sections and about 0.15 inch from the map limit. For sections with more than one half section on a map, place the numbers near the center of the full section. Adjust the section numbers slightly to avoid overprinting other map detail.

- Check the land division corners and numbers for continuity and correctness between maps. The land division system must agree and match between maps.

(3) Transportation

(i) Roads. Identify all interstate, Federal, state, and other roads by placing route emblems with numbers and letters at each end of the road as it appears on the map. Place emblems horizontally and parallel to the neatline. Place the emblem directly on the road image. If the actual roads are plotted, place the emblem on one side of the plotted road. Position additional emblems at road junctions. When roads continue on adjoining maps, place the emblems close to the map neatline. Identify county highways and other roads only where Federal and state highways are sparsely located. Show names of major freeways, parkways, turnpikes, and expressways. Do not name city streets and local roads except in special cases. Use 6 point Univers Condensed Caps for all road names.

(ii) Railroads. Name mainline railroads in 6 point Univers Condensed Caps. Name the railroad at least once per map. Repeat the railroad name when it is intersected by other railroads, or where other features obscure its direction. Omit the words "railroad, railway, system, the, company" from the name. In most cases, omit the word "line" unless it is part of the proper company name. Place the name directly on the feature image.

- If map space is limited, abbreviate the names as in Rand McNally's "Commercial Atlas and Marketing Guide" using one to three em spaces between letters.

MP . . . . Missouri Pacific

A T AND S F . . . . . Atchison Topeka and Santa Fe

D AND R G . . . . . . Denver and Rio Grande

- Omit punctuation and hyphens in railroad names. Avoid using the abbreviations "&" for the word "and". Set component names 1 inch to 2 inches apart on the same side of alignments in clear map spaces. Do not separate multiple word names by more than one em space.

(4) **Place names.** Use place names for concentrations of populations. Lettering of place names is Univers Bold style. Size varies from 8 to 10 point, upper and lower case or all Caps depending on the size of the population. Use the appropriate type and size for varying population sizes:

(b) Population of Place	(c) Type Size and Capitalization
0 to 100	8 Pt C/L
100 to 1000	10 Pt C/L
1000 to 100000	8 Pt Caps
Over 100000	10 Pt Caps

Locate and lay out each place name over or near the main portion of the central area to be identified. Position names so that a direct association with the place being identified is immediately evident. If the place name extends across more than one map, name each map.

Except for crossroads or long two worded names, layout place names in single horizontal alignment in open map spaces. Where possible avoid overprinting other map features. Show two-worded place names on two lines with a 0.10-inch space between base lines of type.

(5) **Miscellaneous Cultural features**

(i) Churches and schools. If churches, schools and other religious structures are to be shown, use their proper names, if known, in two lines spaced 0.10-inch apart. Marginate near their symbol in 8 point Univers Bold C/L. Omit all reference to denomination of religions in the names. Include "High" school and "Junior High" school in the names if known but do not include "Elementary" in elementary school names.

(ii) Public works features. Identify public works features with proper name or descriptive label in 6 point Triumvirate Condensed. These features include pipelines, storage tanks, oil fields, aqueducts, floodgates, tunnels, siphons, fords, locks, bridges, ferries, and underground cable. Label storage tanks either as "GAS", "OIL", or "WATER" and omit operating names. Do not name or label power transmission lines.

(iii) Buildings and Grounds.

- Show the names of technical schools, hospitals, historical monuments, camps, fairgrounds, golf courses, experiment stations, city and county parks, and cemeteries in 6 point Triumvirate Condensed C/L. Lay out the names horizontally inside the feature imagery if space permits. Otherwise place the names outside and marginate near their imagery. Names placed outside the imagery should be horizontal in two lines with a 0.10-inch space between lines of type.

- Show the names of airports, colleges, and universities in two lines in gradation of 6 to 12 point Century Schoolbook C/L or Caps depending on the area of coverage.
- Identify other cultural features and objects with a descriptive label in 6 point Triumvirate Condensed type. Some of the features are: public buildings, shrines, hospitals, historical monuments, fish hatcheries, lighthouses, and other building identifications.

(6) Hydrographic features

(i) Streams. Indicate all natural stream names in Century Schoolbook Italic C/L or CAPS type style but vary the size and spacing of the lettering according to stream width, length, and capacity. Usually, the type size of a stream increases as the stream develops in length and width from its source to a confluence. If the shape, size, or extent of a stream on a particular map is not sufficient for the recommended type size, reduce the type size to accommodate the map space available. Space letters of 10 to 14 point size stream names not less than 2 point spacing.

Place double line stream names between shores where overprinting will not occur. Place type for linear features on the upper side of the feature aligned with the general direction of the feature. Place components of streams on the same side of streams, one to two inches apart when set in small type, two to four inches apart when set in large type, and curved to fit stream alignments. Although stream names may overprint soil boundaries, make every effort to layout the names in clear map spaces along the stream. Name a stream twice on the same map if it is long and meandering.

(ii) Other natural hydrographic features. Show the names of ponds, lakes, reservoirs, swamps, tidal flats, marshes, inlets, coves, channels, passages, straits, sounds, bays, gulfs, seas, oceans, and other hydrographic features. Also use a soil label for water. Since these features exist in many sizes, shapes, and patterns, it is difficult to standardize the type and position of their names. Show all named natural hydrographic features in Century Schoolbook Italic style type, varied in 6, 8, 10, 12 or 14 point, caps or caps and lower case, letter spacing if needed, and in proportion to the extent and size of the areas. Place hydrographic names within their shorelines, where possible, on straight or curved baselines fitting their shapes or patterns. Letter space when the water areas are large or wide. Where names do not fit inside water areas, place the lettering outside, nearby, and in two or more horizontal lines margined to the feature. Select the type size that appears commensurate with the size of the area being named. Use the following guidelines:

Approximate Width of Water Area	Type Size
0.25 inch	8 point C/L
0.5 inch	8 point Caps
1 inch	8 Pt C/L, 8 pt Caps
2 inches	10 pt C/L
larger than 2 inches	10, 12, or 14 pt Caps

Twelve point type is the average maximum size but use 14 point type in exceptionally large areas of oceans, seas, gulfs, bays, and sounds. Space letters of 10 point type or larger not less than 2 point spacings. Match between maps for possible continuation of features to adjoining maps.

In sparsely populated areas where there are few feature names and identifications, name springs if their proper name is known and the site is important. Use 6 point Century Schoolbook Italic C/L.

(iii) Constructed hydrographic features. Show the names of canals, ditches, named miscellaneous water areas, and flood pool line in 6 point Triumvirate Condensed Caps. If a proposed reservoir has more than 5 miles of shoreline, then label the shoreline boundary for identification "Proposed Pool Line".

(7) Hypsographic Features. Show the names of hypsographic features. These include mountain ranges, ridges, peaks, knobs, buttes, hills, canyons, bluffs, plateaus, sinks, summits, gaps, mesas, plains, prairies, passes, reefs, valleys, hollows, meadows, gulches, deserts, washes, faults, escarpments, islands, peninsulas, arroyos, capes, points, landings, beaches, and basins. Use good judgment in portraying the importance of these features because they occur in a great variety of heights, shapes, slopes, flatness, extent, patterns, and configurations. Show hypsographic names in Univers medium style of type, in 6, 8, 10, 12, 14, 16 or 18 point C/L or Caps and letter spaced where required.

Usually, the 8 and 10 point size is adequate for naming land features of small or minor extent. These include knobs, hills, gaps, summits, landings, capes, points, meadows, valleys, canyons, hollows, gulches, washes, and beaches. Letter small features such as points, islands, landings, knobs, and hills in two lines, margined to the feature with variable space between base lines of type depending on size of type selected.

Mountain ranges, mountains, deserts, plateaus, prairies, sinks, plains, ridges, geological faults or escarpments, passes, islands, basins, peninsulas, and reefs are usually large in extent and are usually named in 10 or 12 point type. Use the 14, 16, and 18 point size only for very large features. Place these names on horizontal, angular, straight, or curved baselines. Place the names to cover the feature location employing letter spacing where necessary to cover the extent of the features.

(8) Soil labels. Only show the soil labels that are indicated in the classification and correlation document and applicable amendments. The compilation photobase or overlay is the source for the identification of soil labels for their respective soil delineation. Occasionally, the distinction between cap and lowercase letters that are used for soil labels on the compilation is not clear. The soil legend is the exclusive source for clarification. If the compilation base is an orthophotograph then the soil information is to be digitized prior to the map finishing and the certified SSURGO data are used for supplying the soil labels. If the compilation base is not an orthophotograph, the soil information will not be available in digital format. In the later case, if there are soil labels on the compilation source that are not included in the soil legend, contact the responsible technical representative for resolution.

Place soil labels horizontally and near the geometric center of the soil area. Read the labels from left to right. Where soil labels that do not fit inside the soil delineation, turn the labels at an angle with the area. Where possible, align the angled soil label with the angularity of the soil area. Soil labels that are placed in a near vertical position must read from the bottom of the map to the top. Soil areas longer than approximately 3 inches in any direction require more than one soil label. In elongated or narrow areas, space soil labels 1 to 2 inches apart. Do not place soil labels so that they touch or extend across soil boundaries or other map features. In cases where a soil area is long and narrow and contains a stream, and there is insufficient space to place the soil label at an angle, it is permissible to place the soil label over the stream to avoid using a leader.

Where the soil delineation is too small to contain a label, place the label horizontally outside and adjacent to the soil area and use a leader extending into the proper soil delineation. Only use a leader when absolutely necessary. Leader line widths are 0.007 inches and 0.08 inches in length, and centered across the soil boundary into the soil area being identified. A leader should not cross more than one soil line. The ends of the leader must not touch the soil label or any other line work or detail with the soil area and must terminate within 0.010 inches of its soil label. The leader should be at an angle different from the angle of the soil label.

(d) Data Capture

(1) Digitize each point or line feature within 0.01-inch (0.254 mm) line width of the source document. Follow the centerline of the feature. Represent each line feature with no greater number of coordinate pairs than is necessary to record the line within the 0.01-inch (0.254 mm) accuracy limit. Digitize islands as a continuous line segment with only a beginning and ending node. Connect beginning and ending points of intersecting lines with a common intersecting point.

(2) The map neatline serves as a boundary and forms the maximum extent of the digital data set. Construct it as four straight-line boundary segments. The beginning and ending point of each neatline will be identical to the four corner coordinate values of the orthophoto quadrangle. Explicitly enter these values; do not digitize. Lines intersecting the map neatline must also have a common point of intersection with the map neatline, and must not extend beyond or fall short of the map neatline. The neatline must be a straight line and in the map projection and horizontal datum required for the final data. If the data are developed in a different map projection or datum, or both, map developers must take care to properly clip each USGS quadrangle to the straight neatlines in the projection (UTM) and horizontal datum of the final data.

(3) Establish geographic control using the four corner coordinate values of the orthophoto quadrangle.

(4) Label each map feature with a numeric identification code and assign a descriptive label. The numeric identification code corresponds to the minor code in the modified Digital Line Graph optional format file and in the attribute file for each data layer. The descriptive labels are identical to the descriptive labels in Exhibit 647-13, DLG major and minor codes for soil survey publication features.

(5) Position the coordinate point for the feature label at or near the center of the digitized feature.

(e) Spatial Data Format

Digital data sets for culture and hydrography are, or have been formatted into, full 7.5-minute quadrangle format. Digital data sets in 3.75-minute orthophoto quadrangle format do not need to be merged into a full 7.5-minute quadrangle format.

Collect coordinate values in any internal coordinate system during the digitizing process.

(1) All coordinate data requires the following coordinate reference system:
- (i) Ground based system and projections are Universal Transverse Mercator (UTM).
- (ii) Quadrangles are retained in their appropriate grid zones.
- (iii) Map units are in meters.
- (iv) Horizontal datum is the North American Datum of 1983 that is based upon the Geodetic Reference System of 1980 or the North American Datum of 1927 that is based upon the Clarke 1866 spheroid. The reference system is the same as the digitizing base.
- (v) No x_ or y_coordinate shifts (offsets) are permitted.
- (vi) Format of data coordinates is real.
- (vii) Data structure is in a vector structure.

A modified Digital Line Graph optional format (DLG-3) is the format for storing, maintaining, and distributing the soil survey publication cultural and hydrographic databases. Refer to appendix B in the U.S. Geological Survey National Mapping Program, Technical Instruction, Data Users Guide 1, entitled "Digital Line Graphs from 1:24,000-Scale Maps" 1990 for additional information.

The DLG-3 data structure contains node, line, and area features. Represent point features as degenerate lines in the DLG-3. Provide soil survey publication data in up to 8 separate files for each map. These are:

(i) a culture feature file,
(ii) a culture attribute file,
(iii) a hydrography feature file,
(iv) a hydrography attribute file,
(v) a soil area feature file,
(vi) a soil area attribute file,
(vii) a linear and point feature file, and
(viii) a linear and point feature attribute file.

The attribute files are ASCII files containing alphanumeric labels for the data features. Exhibit 647-8 and 647-9 show sample DLG-3 files for cultural features and its companion attribute file.

(2) Characteristics of the culture and hydrography modified DLG-3:
(i) Two area records -the universe polygon and the area inside of the neatline
(ii) Universe polygon will have major and minor codes of 0; area inside of the neatline will not have major or minor codes
(iii) Linear features are represented as lines
(iv) Point features are represented as degenerate lines
(v) Quadrangle neatline is present and is represented as four separate line records
(vi) Companion attribute file

(3) DLG-3 and Attribute File Relationship. Each feature file has a corresponding attribute file. Each attribute file has one data record for each feature in the DLG-3 file. The attribute file links alpha or alphanumeric labels to the appropriate feature in the DLG-3 file through the major and minor code pairs. The alpha or alphanumeric labels cannot be carried in the major and minor code pairs because the code pairs are defined as integers that are six digits in length. Tab delimit each record without spaces. Each record has a sequential record number, a major code, a minor code and a descriptive label. The major and minor codes and the descriptive labels must match the codes and labels of the DLG record. Attribute the features with the descriptive labels during data capture.

(4) Spatial Data Files Naming Convention. The following convention for soil survey publication data files follows the data set naming convention used in the USGS National Digital Cartographic Database, but with some modifications. The file names are eight characters in length with a three-character extension. A brief description of the naming convention follows:
(i) Sample File Name: tyyxxxzz.qft
(ii) t - indicates type of data (s is currently the only accepted code)
(iii) yy - indicates southeast latitude of the 1 degree block in which the quadrangle resides
(iv) xxx- indicates southeast longitude of the 1 degree block in which the quadrangle resides
(v) zz - is the 7.5 minute section number of the 1-degree block (Table) in which the quadrangle resides (reading left to right from northwest corner)
(vi) q - indicates the 3.75-minute quarter of the 7.5-minute quadrangle expressed as an integer. 7.5- minute quadrangles are coded as "0
(vii) NE - 1
(viii) NW - 2
(ix) SW - 3
(x) SE - 4
(xi) ft - indicates data type
(xii) cf - culture feature DLG-3 file
(xiii) ca - culture attribute file
(xiv) hf - hydrography feature DLG-3 file
(xv) ha - hydrography attribute file

File naming examples for a 3.75- and a 7.5-minute quadrangle culture DLG-3 file are:

s4309101.2cf This quarter-quadrangle is located in the northwest 3.75-minute quarter of the first 7.5-minute quadrangle of the 1-degree block, whose southeast corner is 43-degrees north latitude and 91-degrees west longitude.

s4309125.0cf 7.5-minute quadrangle whose southeast corner is 30 minutes and 00 seconds north latitude and 52 minutes and 30 seconds west longitude of the 1-degree block, whose southeast corner is 43-degrees north latitude and 91-degrees west longitude.

(5) **Postscript Plot Files**. For each published map, combine and process the data and text layers into two plot files in Postscript format. Exhibit 627-5, Feature and Symbol Legend for Soil Survey identifies the publication color of each feature. In addition, all text and marginalia print are black. The postscript files can be level 1 or 2. Level 2 is the preferred choice. The postscript file image area must not exceed 25 inches width by 29.5 inches height. The bounding box defined in the postscript header must not exceed 1800 pica points for the width by 2124 pica points for the height. Embed the fonts that are used within the PostScript file. All line work is to be smooth without skips, overlaps, or other irregularities. All overlays and labels must be outside of the printing area in the lower right corner with the quadrangle and soil survey area name. There are to be no stray markings on the map overlays. The postscript file names use the publication sheet number followed by an underscore, the plate color (either bu for or bk for black) and a ps extension. For example: 26_bu.ps for sheet number 26, blue plate.)

(6) **Delivery Formats**. Submit data to the MLRA regional office on 8-mm tapes, compact discs, or by electronic transfer. Write the data using the UNIX tar command for tapes. The root directories on the media will be /LOCATION with entire data files and /PUB with the postscript files. Document the method and format as part of the label. Specify the density. A label attached should include:

(i) Soil survey area name
(ii) Reading instructions
(iii) Format
(iv) Date
(v) Contact person and telephone number
(vi) Soil survey area symbol and name
(vii) Block size
(viii) The word PUBLICATION

Exhibit 647-1 Suggested Compilation Edit Checklist.

Soil Survey Area Name:____________________
Publication Map Sheet Number ________ of _____________
Field Sheet Numbers:______________________
USGS Quadrangle Name:____________________
Scale: 1:________
Projection and datum:______________________
SW Corner Coordinate Values Lat:___/___/___, Long:___/___/___
Editor's Name:___________________________

Adjoining Sheet Number or Name	Date match completed
North:_____________________	__________
East:_____________________	__________
South:_____________________	__________
West:_____________________	__________

Marginalia
___ Join notes are present and correct
___ Range and Township tics and values are present and correct
___ Coordinate tics and values are present and correct
___ Overlay labels are complete and located in lower right corner
___ Corner tics for digitizing overlays are inked
___ Field sheet numbers are located on edge of compilation base

Culture
___ All items on compilation are on form NRCS-SOI-37A
___ All cultural features are compiled with the correct color and on the appropriate overlay
___ Any errors on the USGS topographic quadrangles have been corrected and identified on "official" set
___ All boundaries are indicated with the appropriate line symbol
___ Roads/emblems are highlighted on USGS topographic quadrangle and correctly transferred to compilation base

___ Railroad names are highlighted on USGS topographic quadrangle and correctly transferred to compilation base

___ Section corners and numbers are indicated
___Cultural features match the compilation imagery

Hydrology
___ All hydrographic features on compilation are on form NRCS-SOI-37A
___ All hydrographic features are compiled with the correct color and on the appropriate overlay
___ All hydrographic features are indicated with the correct symbolization
___ Only streams of ½ inch or longer are compiled
___ All streams match the compilation imagery
___ Hydrographic features names are highlighted on the USGS topographic quadrangles and correctly transferred to compilation base

___ Hydrographic features do not coincide with other features

Soils
___ Each soil map unit delineation has a correct, legible label
___ All soil labels have been properly converted to publication or approved legend
___ There are no common soil lines

___ Soil labels are placed horizontally where space permits
___ All soil lines are completed without skips or overshoots
___ All leaders are properly positioned to insure correct association with the soil unit they represent
___ Soil lines and labels do not coincide with other features
___ Only features identified on form NRCS-SOI-37A are compiled
___ All water areas are compiled on the soils overlay as soil delineations with soil map unit labels

  ___ Miscellaneous land type areas (gravel pits, etc.) are correlated and delineated with a symbol for a standard landform and miscellaneous surface feature if smaller than the minimum size delineation at the given scale

  ___ Water areas less than the acceptable minimum size delineation are shown with the appropriate symbol

  ___ Soil lines delineate landform segments in the landscape

  ___ An exact join exists with adjoining ________________ soil survey area. (repeat for each adjoining survey area or document discrepancies for acceptable joins)

Text
___ All text is correctly spelled and placed in the correct location
___ Text does not obscure the legibility of other features
___ All components of names are placed on the same side of the feature they represent

Materials

The following materials have been accounted for and are organized in protective envelopes:
___ Field sheets
___ Compilation base
___ USGS topographic quadrangle
___ Edit overlay
___ Approved correlated legend
___ Index to field sheets
___ Index to publication map
___ Highway map
___ Compilation checklists are completed and attached to each protective envelope

Miscellaneous
___ All overlays are clean
___ All overlays are brushed off on both sides

Exhibit 647-2 Common Compilation Errors and Editorial Symbols for Action.

1. Soil delineation error

common soil line ? A D
missing soil line A

2. Incorrect soil label

missing soil label ? A
incorrect conversion of field symbol CG
two different labels within one delineation D ?
named water area not identified with soil label for digitizing A
missing leader for soil label A
mismatch between sheets CG ?

3. Mismatch of features between sheets RV D A

4. Mismatch of text between sheets CG A D

any road number, creek names, etc.

5. Features or text mismatch source document

feature appears on source but not on compilation A ?
compilation does not image match field sheet A M AJ D RV CG
features on compilation are not in correct location M

6. Features mismatch NRCS-SOI-37A

feature appears on compilation but not on NRCS-SOI-37A D
feature on NRCS-SOI-37A but not transferred from field sheet to compilation A

7. Incorrect feature

drains too short, less than ½ high in length D
Land Division Corner where corner coincides with neatline A D
linework overshoots T
incorrect symbol for feature CG

8. Incorrect stream symbolization

incorrect stream symbol CG
drainage end added or omitted D A
arrowhead added or omitted or improperly aligned D A AL
arrowheads on streams at neatline where stream continues on adjoining sheets D
drainage turned upstream at junction CG RV
extend drainage to neatline or other feature X

9 Incorrect text

incorrect name or number CG ? D
incorrect spelling SP
incorrect join note CG

10. Omitted label (other than soil) feature A

abbreviation needed A

11. Inconsistent line weight or quality **SM ST**

12. Illegible label/feature **M RP ST RV SM**

label or feature is impossible or hard to read or decipher

13. Incomplete label/feature

Broken linework C CL
linework not connected to other features C
missing name component A
missing leader A

14. Coinciding label/feature **AJ M T D X**

15. Too many or too few labels for clear identification **A D**

soil labels
other labels

16. Soil labels placed outside of soil area or neat lines where space is sufficient inside **M**

17. Improper alignment of soil label/feature

soil labels not positioned horizontally where space permits AL
symbols for standard or ad hoc features not oriented north AJ
labels/leaders correct but improperly positioned for clarity AJ
linework overshoots T

18. Components of name not placed on same side of feature **M**

19. Improper text

incorrect spacing CG
incorrect location M D
incorrect orientation CG AL
leaders do not follow specs AJ
abbreviation needed CG

20. Field sheet numbers are recorded on the compilation sheets **A**

Editorial symbols legend

^.......... Inset
" .... Quote, inches, seconds
#.......... Number
&......... And
'........... Apostrophe, feet, minutes
( ) .... Parentheses
@ .... At
? .... Unknown disposition
A .... Add
AJ........ Adjust
AL....... Align
C .... Connect as indicated
CG ...... Change as shown
CL....... Clean, Centerline
D..........Delete
M....... Move
R........ Repair, restore
RP ..... Replace
RV..... Revise
SM .... Smooth
SP...... Spell
ST...... Strengthen
T........ Trim
X .... Extend
XX .... Remove or delete (map interior only)

Exhibit 647-3 Map Compilation Certification.

____
Soil Survey Area Name

Map Compilation

1. The map compilation was performed according to the NRCS specifications as described in the National Soil Survey Handbook, Part 647.
2. The soil survey was compiled to NRCS approved base maps.
3. Map unit delineations and their labels match across map boundaries and an exact join has been achieved with adjacent surveys (discrepancies are documented for acceptable joins).
4. A 100 percent edit has been completed by the compiling office. Ten percent of the map sheets have received an additional 100 percent edit by the MLRA regional office. These map sheets are listed below.

I certify that all the above statements are true for the following map sheets.

____

MLRA Regional Office Leader Date

Exhibit 647-4 Supplement To A Published Soil Survey Map.

Alpha County, and State soil survey map supplement

In 1994, the map sheets in the Alpha County Soil Survey were digitized cooperatively by the Natural Resources Conservation Service, the _______________, and the ______________. Before or during digitizing, soil lines were transferred from the original map sheets to orthophotos. In the process, some changes in line placement from the original map sheets were made. This was primarily caused by improved photo image registration between the original map sheets and the orthophoto base. Lines were also adjusted because of registration discrepancies between the original soil delineations and USGS topographic features. A few changes, deletions, or additions were also made to soil survey, cultural and hydrographic features. Corrections that had previously been noted on the record copy of the soil survey have been incorporated. This compilation has produced an enhanced, more accurate soil map.

This supplement documents those changes where the original line placements were significantly adjusted, map symbols were corrected, and where soil delineations were added or removed. Other minor changes were recorded and are on file at the field office. All changes in the original line placement were reviewed by a soil scientist with stereo photography or by field visit, or both.

Typical changes include: refined line placement to improve joins between map sheets; more accurate line placement between strongly contrasting map units, such as organic soils and adjoining map units on uplands; and better registration of soil lines to drainage on the photographic image.

This supplement provides a record of all significant changes and should be used with the published soil survey. All changes are arranged by atlas sheet number and section number. Please check to see if there are changes on the atlas sheet of interest. Photocopies of portions of soil map sheets are available upon request.

The recompiled maps were digitized in accordance with Soil Survey Geographic (SSURGO) database standards and the amendment to the soil survey area memorandum of understanding. The digitized soil maps are the official copy for NRCS and USDA programs.

Exhibit 647-5 Example Soil Survey Geographic Data Certification

EXAMPLE – Modify to fit the survey.

SPATIAL DATA

1. Digitizing meets the NRCS standards and specifications as described in Part 647.07 NSSH.
2. Quality control included a ____________________ (100% edit by MLRA soil survey office, for example).
3. Quality assurance included ____
____
________________________(___edit by the MLRA regional office and __ by the NCGC, for example).
4. Soil and survey boundaries are digitized within a ________(0.01-inch (0.254 mm),for example) line width of the published or revised soil survey.
5. Where a soil area boundary line intersects a quadrangle boundary, the line matches the line in the adjoining quadrangle within 0.01 inch (0.254 mm) measured centerline to centerline.
6. Map data are stored in a ________________(vector, for example) format.
7. Map data are in ____________________(Digital Line Graph optional, for example) format.
8. Digital Line Graph optional format files contain major/minor pairs in area records. A conversion legend is provided for each Digital Line Graph file. Files have been properly named.
9. Digital soil data sets are in or have been formatted into _____-minute quadrangle format.
10. Map data have been sent to the National Cartography and Geospatial Center for archiving.

ATTRIBUTE DATA

1. Data base tables are current and accurate.
2. Data base tables have been sent to the National Cartography and Geospatial Center for archiving.

METADATA

Metadata template has been completed and sent to the National Cartography and Geospatial Center for archiving.

I certify that the data have passed a 100 percent state edit.

____

State Soil Scientist Date

____

MLRA Regional Office Leader Date

I certify that the data meets all of the above certification specifications and are ready for archiving and distribution.

____

State Conservationist Date

Exhibit 647-6 DLG Major and Minor Codes for Soil Survey Publication

Label	Major	Minor	Description
HILL	900	303	Prominent hill or peak (obsolete)
SPRN	905	300	Spring
AWEL	905	302	Artesian well
IWEL	905	329	Irrigation well
PDDR	905	222	Perennial double line stream (label) (obsolete)
PSDR	905	223	Perennial single line stream
INDR	905	224	Intermittent stream
UCDR	905	228	Unclassified stream
DEND	953	0xxx	Drainage end, where x= angle of rotation in 5 degree increments, measured counter clockwise from the feature origin assigned parallel to the horizontal map neatline.
DCAN	905	225	Double line canal (label) (obsolete)
DDIT	905	226	Perennial drainage and/or irrigation ditch
IDIT	905	227	Intermittent drainage and/or irrigation ditch
UCDIT	905	229	Unclassified drainage and/or irrigation ditch
FPOOL	909	222	Flood pool line
CANB	909	197	Canada boundary
MEXB	909	198	Mexico boundary
WATB	909	199	Open water boundary
SB	951	210	State boundary
CB	952	211	County boundary
INCB			Incorporated city (obsolete, use civil division symbol)
CIVB	909	100	Civil township, district, precinct, or barrio boundary
NFOR	909	104	National forest boundary
NPAR	909	103	National park boundary
NSCE	909	106	National scenic waterway, riverway, wild & scenic river or wilderness
NWIL	909	105	National wildlife refuge, game reserve, or fish hatchery boundary
SFOR	909	132	State forest boundary
SPAR	909	130	State park boundary
SWIL	909	131	State wildlife refuge, game reserve, or fish hatchery boundary
CPAR	909	102	City, county, or private park boundary
TICK	930	301	State coordinate tick
FARM	909	218	Land grant, experiment station, or farm boundary
LCT	930	1	Land grant land division corner, center (obsolete)
LSE	930	2	Land grant land division corner, SE (obsolete)
LNW	930	3	Land grant land division corner, NW (obsolete)
LNE	930	4	Land grant land division, corner, NE (obsolete)
LSW	930	5	Land grant land division, corner, SW (obsolete)
LSESW	930	6	Land grant land division, corner, SESW (obsolete)

Label	Major	Minor	Description
LSWNW	930	7	Land grant land division, corner, SWNW (obsolete)
LSENE	930	8	Land grant land division, corner, SENE (obsolete)
LNENW	930	9	Land grant land division, corner, NENW (obsolete)
SCT	930	10	Section land division corner, center
SSE	930	11	Section land division corner, SE
SNW	930	12	Section land division corner, NW
SNE	930	13	Section land division corner, NE
SSW	930	14	Section land division corner, SW
SSESW	930	15	Section land division corner, SESW
SSWNW	930	16	Section land division corner, SWNW
SSENE	930	17	Section land division corner, SENE
SNENW	930	18	Section land division corner, SENW
SLAB1	930	301	Section label, 1
SLAB2	930	302	Section label, 2
SLAB3	930	303	Section label, 3
SLAB4	930	304	Section label, 4
SLAB5	930	305	Section label, 5
SLAB6	930	306	Section label, 6
SLAB7	930	307	Section label, 7
SLAB8	930	308	Section label, 8
SLAB9	930	309	Section label, 9
SLAB10	930	310	Section label, 10
SLAB11	930	311	Section label, 11
SLAB12	930	312	Section label, 12
SLAB13	930	313	Section label, 13
SLAB14	930	314	Section label, 14
SLAB15	930	315	Section label, 15
SLAB16	930	316	Section label, 16
SLAB17	930	317	Section label, 17
SLAB18	930	318	Section label, 18
SLAB19	930	319	Section label, 19
SLAB20	930	320	Section label, 20
SLAB21	930	321	Section label, 21
SLAB22	930	322	Section label, 22
SLAB23	930	323	Section label, 23
SLAB24	930	324	Section label, 24
SLAB25	930	325	Section label, 25
SLAB26	930	326	Section label, 26
SLAB27	930	327	Section label, 27
SLAB28	930	328	Section label, 28
SLAB29	930	329	Section label, 29
SLAB30	930	330	Section label, 30
SLAB31	930	331	Section label, 31
SLAB32	930	332	Section label, 32

Label	Major	Minor	Description
SLAB33	930	333	Section label, 33
SLAB34	930	334	Section label, 34
SLAB35	930	335	Section label, 35
SLAB36	930	336	Section label, 36
LLABXXX	903	3001	Land grant labels, XXX=label value
LIMT	909	219	Limit of soil survey
NEAT	909	220	Field sheet matchline and neatline
PPUB	909	221	Previously published survey boundary
AIRP	909	403	Airport or airfield boundary (obsolete)
AIRS	920	311	Small airport or airfield symbol
CEME	909	420	Cemetery boundary (obsolete)
CEMS	900	320	Small cemetery symbol
CROS	900	321	Cemetery cross (obsolete)
OILF	920	421	Oil field boundary (obsolete)
FENC	920	206	Fence (obsolete)
PIPE	919	201	Pipeline (obsolete)
LINE	919	202	Power transmission line (obsolete)
DVRD	919	214	Divided road (Normally not shown)
UDRD	917	215	Undivided road (Normally not shown)
FRRD	917	216	Farm or ranch road (Normally not shown)
ROUT	917	217	Reservation, park, or military route
VTRL	970	212	Vehicle trail (Normally not shown)
PTRL	970	211	Pedestrian trail (Normally not shown)
RAIL	918	201	Railroad (obsolete)
LVWR	920	205	Levee with road (obsolete)
LVXR	920	204	Levee without road (obsolete)
LVRR	920	207	Levee with railroad (obsolete)
MDAM	905	406	Medium or small dam (obsolete)
CHUR	920	402	Church
OREL	920	404	Other religious structure
HOUS	920	305	Farmstead, house
SCHL	920	403	School
LTHS	920	306	Lighthouse
HIST	920	301	Historical marker
LOOK	920	614	Lookout tower
PTANK	920	308	Petroleum storage tank
WTANK	920	310	Water storage tank
GWEL	920	606	Gas and oil well
WIND	905	305	Windmill
LOCO	920	312	Located object
SOIS	900	319	Soil sample site

Exhibit 647-7 Symbol and Font Specifications

[This material is available from the National Cartography and Geospatial Center.]

Exhibit 647-8 Sample DLG File for Cultural Features

```
USDA-NRCS DLG DATA - CHARACTER FORMAT - 8-13-96 VERSION
BALTIMORE WEST 2, MD                    1996    12000
USDA/NRCS SSURGO DATA; NAD83
       3       1      18       2 3.04800000000D-01      4       0       4       1
    0.000000000000000D+00    0.000000000000000D+00    0.000000000000000D+00
    0.000000000000000D+00    0.000000000000000D+00    0.000000000000000D+00
    0.000000000000000D+00    0.000000000000000D+00    0.000000000000000D+00
    0.000000000000000D+00    0.000000000000000D+00    0.000000000000000D+00
    0.000000000000000D+00    0.000000000000000D+00    0.000000000000000D+00
1.00000000000D+00 0.00000000000D+00 0.00000000000D+00 0.00000000000D+00
SW         39.250000   -76.750000          348994.40  4345979.27
NW         39.375000   -76.750000          349262.94  4359852.69
NE         39.375000   -76.625000          360030.47  4359651.44
SE         39.250000   -76.625000          359781.12  4345778.20
SPECIAL_FEATURES         0      14      14 01       2       2 010      13      13     1
N      1    349128.58   4352915.94      0      2      0      0      0
    1  3
N  2  354517.16 4352813.50   0   2   0   0   0
    4  -1
N  3  349262.94 4359852.69   0   2   0   0   0
    •  3   2
N  4  354646.72 4359750.20   0   2   0   0   0
    •  4  -2
N      5    354639.32   4359415.28      0      1      0      0      0
       5
N      6    352481.26   4352852.22      0      1      0      0      0
    •  5
N      7    352613.48   4358404.67      0      2      0      0      0
6      -6
N      8    354464.08   4354664.80      0      2      0      0      0
7      -7
N  9  352643.56 4359387.44   0   2   0   0   0
8      -8
N  10  354510.25 4357649.49   0   2   0   0   0
9      -9
N  11  354525.30 4356570.02   0   2   0   0   0
10     -10
N  12  352618.94 4355473.65   0   2   0   0   0
11     -11
```

N 13 353879.72 4354574.56 0 2 0 0 0

12 -12

N 14 354231.07 4356074.91 0 2 0 0 0

13 -13

```
A    1   348128.55   4351813.06    0    4    0    1    0    0
     1    4    -2    -3
     0    0
A    2   351888.83   4356332.41    0    4    0    0    0    0
  •  1    3    2    -4
L    1    1    2    1    0                2    0    0
  349128.58  4352915.94  354517.16  4352813.50
L    2    3    4    0    1                2    0    0
  349262.94  4359852.69  354646.72  4359750.20
L    3    1    3    0    1                2    0    0
  349128.58  4352915.94  349262.94  4359852.69
L    4    2    4    1    0                2    0    0
  354517.16  4352813.50  354646.72  4359750.20
L    5    5    6    0    0                9    1    0
  354639.32  4359415.28  353796.13  4359433.42  352595.10  4359452.90
  352574.99  4358399.09  352559.58  4357500.54  352540.89  4356332.37
  352519.10  4355081.30  352492.89  4353546.81  352481.26  4352852.22
L    6    7    7    0    0                2    1    0
  352613.48  4358404.67  352613.48  4358404.67
  974   26
L    7    8    8    0    0                2    1    0
  354464.08  4354664.80  354464.08  4354664.80
  974   129
L    8    9    9    0    0                2    1    0
  352643.56  4359387.44  352643.56  4359387.44
  974   140
L    9    10   10   0    0                2    1    0
  354510.25  4357649.49  354510.25  4357649.49
  974   140
L    10   11   11   0    0                2    1    0
  354525.30  4356570.02  354525.30  4356570.02
  974   129
L    11   12   12   0    0                2    1    0
  352618.94  4355473.65  352618.94  4355473.65
  974   26
L    12   13   13   0    0                2    1    0
  353879.72  4354574.56  353879.72  4354574.56
  920   402
L    13   14   14   0    0                2    1    0
  354231.07  4356074.91  354231.07  4356074.91
  920   403
```

Exhibit 647-9 Sample Attribute File for Cultural Features

1			
2			
3			
4			
5	952	5	CB005
6	974	26	S26
7	974	129	S129
8	974	140	S140
9	974	140	S140
10	974	129	S129
11	974	26	S26
12	920	402	CHUR
13	920	403	SCHL

Exhibit 647-10 Map Finishing Checklist

Soil Survey Area Name:
Publication Map Sheet Number___________of _____
Field Sheet Numbers:___________
USGS Quadrangle Name:
Scale 1:_________
UTM zone ____and datum_____

SW Corner Coordinate Values Lat___/___/___, Long:___/___/___
Editor's Name

Adjoining Sheet Number and Quadrangle Name: Date match Completed:
North:______________ __________
East:______________ __________
South:______________ __________
West:______________ __________
___ All features join from map to map
Marginalia
___ Join notes are present and correct
___ Range and township tic and values are present and correct
___ Soil Survey Area Title is correct and accurately placed
___ Publication sheet number is correct
___ Source note is accurate and correctly located

Culture
___ All cultural features appearing on the proof plots are approved in the NRCS-SOI-37A and are the correct symbol and line weight
___ All boundaries are indicated in the appropriate line symbol
___ All road emblems are correct and accurately placed
___ Section corners and number have been correctly indicated
___ All cultural features match the publication imagery
___ DLG file containing all cultural information is correct and properly named

Hydrography
___ All hydrographic features appearing on the proof plots are approved in the NRCS-SOI- 37A and are the correct symbol and line weight
___ All hydrographic features match the publication imagery
___ Hydrographic features do not coincide with other publication features
___ All lines are complete without skips or overshoots
___ DLG file containing the hydrographic information is correct and properly named

Soils
___ Soil data is derived from a copy of the certified Soil Survey Geographic Data Base (SSURGO)
___ Soil labels are placed horizontally where space permits
___ All soil lines are complete without skips or overshoots
___ All leaders are properly positioned to insure correct association with the soil unit they represent
___ Soil lines and labels do not coincide with other features
___ All areas of water are labeled with the appropriate soil map unit label.

Text

___ All text is correctly spelled and placed in the correct location

___ All text is in the appropriate font style and size for all named features

Materials

The following materials are available:

___ Compilation materials including photobases and overlays

___ Checkplots of each publication map with correct features in black or blue ink

___ USGS Topographic quadrangles

___ Index to publication maps

___ Final correlation document

___ Certification letter

___ 8 mm tape, computer disk, or electronic file with DLG's and postscript files

Exhibit 647-11 Map Finishing Certification

Soil Survey Area Name

Map Finishing

1. The map finishing was performed according to the NRCS specifications as described in Part 647, Soil Map Development, 2000.
2. The soil data are derived from the certified Soil Survey Geographic Database.
3. A 100 percent edit has been completed.

I certify that all of the above statements are true.

MLRA regional office Leader　　　　　　　　　　　　　　　　　Date

Exhibit 647-12 Glossary.

Acetate - A plastic film of 3 or 4 mil thickness used as an editing overlay.

Ad hoc features - Ad hoc features are special surface soil features too small to delineate at the mapping scale, but are large enough and contrasting enough to significantly influence use and management. Ad hoc features are not mapped when the feature they represent is a common component in the map unit. Features that are common components in the map unit should be named, described, and located on the landscape in the map unit description. When mapped, ad hoc features are represented as points or lines.

Approved symbols - Soil survey, cultural, and hydrographic features that have been approved and certified during progressive or final correlation.

Arc-node digitizing - One method of digitizing points, lines, and polygons using a digitizing tablet: Digitizing a line starts at a node, intersection, or junction and stops at the next node, intersection, or junction, then the coordinates are recorded. Also called line-segment digitizing.

Attribute - A characteristic of a geographic feature. Attribute data are linked or related to a feature by an identifier. For example, a soil symbol is linked to an attribute that describes the percentage of slope for the map unit area.

Base map - Planimetric line maps used to plan or to compile data for production of specialized maps.

Coinciding features - Any features that occupy the same place in space.

Compilation - The production of a new map from existing maps, aerial photographs, surveys, new data, and other sources. The new map is generally a geodetically controlled map.

Compilation bases - Base maps, to which previously collected data is transferred, used for map finishing or digitizing. They are generally orthophotographs or rectified photographs.

Contact print - A print made by contacting the emulsion surface of an original negative with photographic film or paper to make print. Generally a negative is contacted with positive photographic paper or film for print.

Continuous tone - A photographic term that denotes an image which has not been screened and contains unbroken, gradient tones from black to white, and may either be in negative or positive form. Aerial photographs are an example of a continuous tone image.

Conventional features - Conventional features are natural or manmade objects or situations that are represented graphically with standard symbols and adopted by Federal mapping agencies. These features are referred to as cultural and hydrographic features.

Coordinate pair - A set of cartesian coordinates describing the two-dimensional location of a point, line, or polygon feature in relation to the common coordinate system of the database.

Cultural features - Any feature created or modified by humans

Degenerate line - A line that has zero length (i.e., it has two nodes with the same coordinate values).

Digital - Of or relating to data in the form of numerical digits in binary form.

Digital Line Graph (DLG) - A comprehensive topological vector format data structure developed by the U.S. Geological Survey. Often referred to as DLG, DLG-3, or DLG Optional format. Used for storing and distributing digital data.

Digitizing - The process of converting information shown on an analog map into a digital format of x and y coordinates for use in a computer.

Edge matching - An editing procedure to ensure that all features crossing adjacent map sheets have the same edge locations, attribute descriptions, and feature classes.

Export - The process of transferring data or software from one system to another system.

Feature - A representation of a geographic entity, such as a line, point, or polygon.

Field mapping imagery - Rectified or nonrectified aerial photographs used for mapping soils or other land features in the field. Field mapping media is generally a paper print with a surface which will take pencil or ink. Sometimes referred to as field map sheet.

Field sheet - Any kind of map provided to field personnel for use in recording collected data. Generally these are photographs of various kinds including mosaics, unrectified and rectified orthophotographs, and high or low altitude flights in varying formats, sizes, and scales.

Film positive - A thin, flexible, transparent sheet of stable plastic material with a positive image.

Geographic Information System (GIS) - A combination of software, hardware, data, and people used to input store, manipulate, analyze, and display geographically referenced spatial and associated attribute information.

Geographic coordinates - A spherical coordinate system for defining the position of points on the earth.

Georeference - The process of establishing the relationship between page coordinates on an analog map and known real-world coordinates.

Halftone - The reproduction of continuous-tone photography through a crossline or contact screen that converts the image into dots of various sizes.

Halftone negative - A halftone is any photomechanical printing surface or the impression in which detail and tone values are represented by a series of evenly spaced dots of varying size and shape, varying in direct proportion to the intensity of the tones they represent. Contrast with continuous tone. A negative is a photographic image on film, plate or paper in which the subject tones to which the emulsion is sensitive are reversed or complementary. A halftone negative is the combination of the definitions of the composite terms.

Hydrography - The science of the measurement, description, and mapping of the surface water of the earth.

Index map - Maps that show the location or coverage of other maps. Examples are the soil survey map sheet index and the USGS topographic quadrangle index.

Index to field map sheets - A map of a smaller scale on which is depicted the location of field map sheets, an index to field map sheets is used for locating field map sheets and is used to reference to the publication map sheets.

Label - A description of a feature.

Leaders - A short line pointing to a label. Used to lead the eye across a space too small or narrow to contain the label.

Limit of soil survey - A boundary that marks the extent of soil survey mapping in a soil survey area. A soil survey area is usually a county, but may consist of multiple counties, parts of counties, or coincide with other political boundaries, physiographic boundaries, or general land office survey sections.

Line - A set of ordered coordinates that represents the shape of a geographic entity too narrow to be displayed as an area.

Line-segment digitizing - See Arc-node digitizing.

Manual digitizing - The process of converting an analog map or other graphics display into a digital format with the use of a digitizing tablet and manually entering coordinates with a cursor.

Manuscript - Synonymous with document

Map finishing - The final transfer of all map features to publication format by either manual (scribing) or digital (plotting) methods. The end products of the process are press ready film negatives.

Metadata - Metadata are data about the content, quality, condition, and other characteristics of data.

Mylar - A polyester film specially suitable for its mechanical strength and dimensional stability. Provided in varying thicknesses.

Neatline - The line surrounding or limiting the image area of the map.

Negative - Film containing an image in which the values of the original are reversed so that the dark areas appear light, and vise versa.

Node - The beginning or ending location of a line, the location where lines connect, or the location where lines intersect.

Nominal scale - The actual scale (no rectification) at which photography is flown.

Orthophotography - An image in which individual parts have been shifted to correct displacements caused by tip, tilt, and relief.

Orthophoto quadrangle - Maps prepared from high-resolution aerial photographs that are corrected to eliminate the displacements of perspective, camera tilt, and terrain relief. They are scale true, meet national map accuracy standards, and permit accurate linear or area measurements.

Photobase positive - A term generally used to describe halftone positive film print, prepared from a halftone negative, which is used to compile soil mapping from field sheets. Photobase positives are sometimes referred to as atlas sheets, preliminary compilation worksheets, and photobases. All refer to the materials that can be used to scribe or digitize accurately.

Planimetric map - A large-scale map with all features projected perpendicularly onto a horizontal datum plane so that horizontal distances can be measured on the map with accuracy.

Point - A single x, y coordinate for a geographic feature too small to be represented as an area or line.

Polygon - A closed area that is described by a string of coordinates that represent the boundary of the area. The beginning and ending points are the same. A series of attributes are usually assigned to the set of boundary coordinates that make up the unit.

Positive - Film containing an image in which the dark and light values are the same as the original. The reverse is a negative.

Publication index - A map developed using a county highway map as a base which depicts the layout of a soil survey map sheets (index to map sheets for publication). It generally includes the publication sheet numbers that are referenced with topographic quadrangles and longitude and latitude graticules.

Raster - A regular grid or array of cells covering a spatial area. A raster is often viewed as consisting of rows and columns of grid cells.

Raster scanning - See Scanning.

Raster digitizing - See Scanning.

Resolution - The accuracy at which the location and shape of map features can be depicted for a given map scale.

Scale - The relationship between a distance on a map and the corresponding distance on the earth.

Scanning - The process of using a device, generally referred to as a scanner, to capture a raster copy of a map in a digital bit-map or binary format and saving it in a computer readable file. This process is also an approach to convert black and white or color aerial photography into a digital format depicting up to 256 shades of gray or a nearly infinite number of color shades and hues.

Source document - Any document that is used as a source for providing information. For example, source document for compilation is the field sheet. For scan digitizing, it is the overlay to which the compiled information has been transferred.

Special features - Symbols with unique definitions and uses that are standard to a specified group of users, but not adopted by all mapping agencies. Examples of special features include those identified for soil survey and SSURGO on the NRCS-SOI-37A legend.

Soil Survey Geographic (SSURGO) database - The most detailed in scale of the three NRCS soil geographic databases. Mapping is generally at scales of 1:12,000 or 1:24,000, but may range to 1:63,360 scale. It consists of geo-referenced digital spatial data, metadata, and a tabular soil database, which gives the proportionate extent of the component soils and their properties for each map unit.

Soil area - A delineation of the mapped soil unit. It is identified by a symbol. A soil boundary depicts the limit of the soil area (polygon).

Soil legend - A list of the soil map symbols and their names.

Spatial data - Data pertaining to the location of geographical entities together with their spatial dimensions. Spatial data are classified as point, line, and polygon.

Stable base material - Film material of sufficient thickness or chemical composition to be resistant to physical dimensional changes caused by changes in temperature or humidity.

Text - Any lettered information that appears on maps.

Topology - A procedure that uses lists of features for explicitly defining spatial relationships. For example, an area is defined by the chains (arcs) comprising its border.

United States National Cartographic Standards for Spatial Accuracy - The standards that define spatial accuracy as it pertains to map products at scales of (NCSSA) 1:250,000 or larger produced by Federal agencies. They supersede the National Map Accuracy Standards (NMAS) issued June 10, 1941, and most recently revised on June 17, 1947, by the former U.S. Bureau of the Budget.

Vector - A line showing the direction and distance between vertices. A vertex is the termination or intersection of lines or curves.

Vector data - A form of digital data comprising x, y coordinate representations that are portrayed by points, lines (strings of points), or polygons (closed lines).

Vector digitizing - See Arc-node digitizing (line-segment) definition.

Exhibit 647-13 SSURGO Metadata Template.

Identification Information

Citation
  Originator: U.S. Department of Agriculture, Natural Resources Conservation Service
  Publication Date: ___(1)___
  Title: Soil Survey Geographic (SSURGO) database for ________(2)___________
  Publication Information
    Publication Place: Fort Worth, Texas
    Publisher: U.S. Department of Agriculture, Natural Resources Conservation Service

Description
  Abstract: This data set is a digital soil survey and generally is the most detailed level of soil geographic data developed by the National Cooperative Soil Survey. The information was prepared by digitizing maps, by compiling information onto a planimetric correct base and digitizing, or by revising digitized maps using remotely sensed and other information.

  This data set consists of georeferenced digital map data and computerized attribute data. The map data are in a __(3)__ minute quadrangle format and include a detailed, field verified inventory of soils and nonsoil areas that normally occur in a repeatable pattern on the landscape and that can be cartographically shown at the scale mapped. A special soil features layer (point and line features) is required. This layer displays the location of features too small to delineate at the mapping scale, but they are large enough and contrasting enough to significantly influence use and management. The soil map units are linked to attributes in the Map Unit Record relational database, which gives the proportionate extent of the component soils and their properties.

  Purpose: SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.

  Supplemental Information: Digital versions of hydrography, cultural features, and other associated layers that are not part of the SSURGO data set may be available from the primary organization listed in the Point of Contact.

Time Period of Content
  Single Date/Time
    Calendar Date: ____(4)_____
  Currentness Reference: publication date

Status
  Progress: Complete
  Maintenance and Update Frequency: As needed

Spatial Domain
  Bounding Coordinates
    West Bounding Coordinate: _______(5)_______
    East Bounding Coordinate: _______(6)_______
    North Bounding Coordinate: _______(7)_______
    South Bounding Coordinate: _______(8)_______

Keywords
  Theme
    Theme Keyword Thesaurus: None
    Theme Keyword: soil survey
    Theme Keyword: soils
    Theme Keyword: Soil Survey Geographic
    Theme Keyword: SSURGO
  Place
    Place Keyword Thesaurus: Counties and County Equivalents of the States of the United States and the District of Columbia (FIPS Pub 6-3)
    Place Keyword: ________(9)______

    Place Keyword Thesaurus: Counties and County Equivalents of the States of the United States and the District of Columbia (FIPS Pub 6-3)
    Place Keyword: ________(10)______

    Place Keyword Thesaurus: USGS Topographic Map Names Data Base
    Place Keyword: _____________(11)_____________
    Place Keyword: _____________(11)_____________
    Place Keyword: _____________(11)_____________
    Place Keyword: _____________(11)_____________
    Place Keyword: _____________(11)_____________

Access Constraints: None

Use Constraints: The U.S. Department of Agriculture, Natural Resources Conservation Service, should be acknowledged as the data source in products derived from these data.

This data set is not designed for use as a primary regulatory tool in permitting or citing decisions, but may be used as a reference source. This is public information and may be interpreted by organizations, agencies, units of government, or others based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions that they make. The Natural Resources Conservation Service will not perform any evaluations of these maps for purposes related solely to State or local regulatory programs.

Photographic or digital enlargement of these maps to scales greater than at which they were originally mapped can cause misinterpretation of the data. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale. The depicted soil boundaries, interpretations, and analysis derived from them do not eliminate the need for onsite sampling, testing, and detailed study of specific sites for intensive uses. Thus, these data and their interpretations are intended for planning purposes only. Digital data files are periodically updated. Files are dated, and users are responsible for obtaining the latest version of the data.

Point of Contact
  Contact Organization Primary
    Contact Organization: U.S. Department of Agriculture, Natural Resources Conservation Service
    Contact Position: State Soil Scientist
    Contact Address
      Address Type: mailing address
      Address: ____________(12)____________
      City: ____________(13)____________

State or Province: ______(14)______
Postal Code: ______(15)______
Contact Voice Telephone: ______(16)______
Contact Facsimile Telephone: ______(17)______
Contact TDD/TTY Telephone: 202 720 7808

Cross Reference:
Citation
Originator: U.S. Department of Agriculture, ______(18)______
Publication Date: ______(19)______
Title: Soil Survey of ______(20)______
Geospatial Data Presentation Form: text, table, map
Description
Abstract: This soil survey contains information that can be applied in managing farms and wetlands(what about BLM, USFS, etc. land ?) ; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Purpose: This soil survey depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.

Data Quality Information

Attribute Accuracy
Attribute Accuracy Report: Attribute accuracy is tested by manual comparison of the source with hard copy plots and/or symbolized display of the map data on an interactive computer graphic system. Selected attributes that cannot be visually verified on plots or on screen are interactively queried and verified on screen. In addition, the attributes are tested against a master set of valid attributes. All attribute data conform to the attribute codes in the signed classification and correlation document and amendment(s).

Logical Consistency Report: Certain node/geometry and topology GT-polygon/chain relationships are collected or generated to satisfy topological requirements (the GT-polygon corresponds to the soil delineation). Some of these requirements include: chains must begin and end at nodes, chains must connect to each other at nodes, chains do not extend through nodes, left and right GT-polygons are defined for each chain element and are consistent throughout, and the chains representing the limits of the file (neatline) are free of gaps. The tests of logical consistency are performed using vendor software. The neatline is generated by connecting the explicitly entered four corners of the digital file. All data outside the enclosed region are ignored and all data crossing these geographically straight lines are clipped at the neatline. Data within a specified tolerance of the neatline are snapped to the neatline. Neatline straightening aligns the digitized edges of the digital data with the generated neatline (i.e., with the longitude/latitude lines in geographic coordinates). All internal polygons are tested for closure with vendor software and are checked on hard copy plots. All data are checked for common soil lines (i.e., adjacent polygons with the same label). Quadrangles are edge matched within the soil survey area and edge locations generally do not deviate from centerline to centerline by more than 0.01 inch. ______(20a)______

Completeness Report: A map unit is a collection of areas defined and named the same in terms of their soil and/or nonsoil areas. Each map unit differs in some respect from all others in a survey area and is uniquely identified. Each individual area is delineated as an area, point, or line segment. Each map unit consists of one or more components.

Soil scientists identify small areas of soils or miscellaneous (nonsoil) areas that have properties and behavior significantly different than the named soils in the surrounding map unit. These minor components may be indicated as standard landform and miscellaneous surface features or as ad hoc features. If they have a minimal effect on use and management, or could not be precisely located, they may not be indicated on the map.

Specific National Cooperative Soil Survey standards and procedures were used in the classification of soils, design and naming of map units, and location of other special soil features. These standards are outlined in Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS; Agricultural Handbook 436, Soil Taxonomy, 2nd edition, Soil Survey Staff, 1999, USDA, NRCS; and all Amendments; Keys to Soil Taxonomy, Soil Survey Staff, (current issue); National Soil Survey Handbook, title 430-VI.

The actual composition and interpretive purity of the map unit delineations were based on data collected by scientists during the course of preparing the soil maps. Adherence to National Cooperative Soil Survey standards and procedures is based on peer review, quality control, and quality assurance. Quality control is outlined in the memorandum of understanding for the soil survey area and in documents that reside with the Natural Resources Conservation Service state soil scientist. Four kinds of map units are used in soil surveys:consociations, complexes, associations, and undifferentiated groups.

Consociations - Consociations are named for the dominant soil. In a consociation, a single soil taxon and similar soils dominate delineated areas. At least one half of the pedons in each delineation are of the same soil component, or are so similar to the named soil that major interpretations are not affected significantly. The total amount of dissimilar inclusions of other components in a map unit generally does not exceed about 15 percent if limiting and 25 percent if non-limiting. A single component of a dissimilar limiting inclusion generally does not exceed 10 percent if very contrasting.

Complexes and associations - Complexes and associations are named for two or more dissimilar components with the dominant component listed first. They occur in a regularly repeating pattern. The major components of a complex cannot be mapped separately at a scale of about 1:24,000. The major components of an association can be separated at a scale of about 1:24,000. In each delineation of either a complex or an association, each major component is normally present, though their proportions may vary appreciably from one delineation to another. The total amount of inclusions in a map unit that are dissimilar to any of the major components does not exceed 15 percent if limiting and 25 percent if non-limiting. A single kind of dissimilar limiting inclusion usually does not exceed 10 percent.

Undifferentiated groups - Undifferentiated groups consist of two or more components that do not always occur together in the same delineation, but are included in the same named map unit because use and management are the same or similar for common uses. Every delineation has at least one of the major components and some may have all of them. The same principles regarding proportion of inclusions apply to undifferentiated groups as to consociations.

Minimum documentation consists of three complete soil profile descriptions that are collected for each soil added to the legend, one additional per 3,000 acres mapped; three 10 observation transects for each map unit, one additional 10 point transect per 3,000 acres.

A defined standard or level of confidence in the interpretive purity of the map unit delineations is attained by adjusting the kind and intensity of field investigations. Field investigations and data collection are carried out in sufficient detail to name map units and to identify accurately and consistently areas of about ___(21)___ acres.

Positional Accuracy
Horizontal Positional Accuracy

Horizontal Positional Accuracy Report: The accuracy of these digital data is based upon their compilation to base maps that meet National Map Accuracy Standards. The difference in positional accuracy between the soil boundaries and special soil features locations in the field and their digitized map location is unknown. The locational accuracy of soil delineations on the ground varies with the transition between map units.

For example, on long gently sloping landscapes the transition occurs gradually over many feet. Where landscapes change abruptly from steep to level, the transition will be very narrow. Soil delineation boundaries and special soil features generally were digitized within 0.01 inch of their locations on the digitizing source. The digital map elements are edge matched between data sets. The data along each quadrangle edge are matched against the data for the adjacent quadrangle. Edge locations generally do not deviate from centerline to centerline by more than 0.01 inch.

Lineage
  Source Information
    Source Citation
      Originator: ___________(22)___________
      Publication Date: ___(23)___
      Title: ___________(24)___________
      Geospatial Data Presentation Form: ___________(25)___________
      Publication Information
        Publication Place: ___________(26)___________
        Publisher: ___________(27)___________
      Source Scale Denominator: ___(28)___
      Type of Source Media: ___(29)___
      Source Time Period of Content
        Single Date/Time
          Calendar Date: ___(30)___
      Source Currentness Reference: ___________(31)___________
      Source Citation Abbreviation: ___________(32)___________
      Source Contribution: ___________(33)___________
    Source Citation
      Originator: ___________(22)___________
      Publication Date: ___(23)___
      Title: ___________(24)___________
      Geospatial Data Presentation Form: ___________(25)___________
      Publication Information
        Publication Place: ___________(26)___________
        Publisher: ___________(27)___________
      Source Scale Denominator: ___(28)___
      Type of Source Media: ___(29)___
      Source Time Period of Content
        Range of Dates/Times
          Beginning Date: ___(30a)___
          Ending Date: ___(30b)___
      Source Currentness Reference: _________________(31) _________________
      Source Citation Abbreviation: ___________(32)___________
      Source Contribution: ______________________(33) ______________________

Process Step
  Process Description: ______________________(34) ______________________
  Process Date: ___(35)___

Source Used Citation Abbreviation: __________(36)__________

Process Step
Process Description: ______________________(34) _____________________
Process Date: ___(35)___
Source Used Citation Abbreviations: __________(36)__________

Spatial Data Organization Information

Direct Spatial Reference Method: Vector

Spatial Reference Information

Horizontal Coordinate System Definition
Planar
Grid Coordinate System Name: Universal Transverse Mercator
Universal Transverse Mercator
UTM Zone Number: ___(37)___
Transverse Mercator
Scale Factor at Central Meridian: 0.9996
Longitude of Central Meridian: ___(38)___
Latitude of Projection Origin: 0.0
False Easting: 500000
False Northing: 0.0
Planar Coordinate Information
Planar Coordinate Encoding Method: coordinate pair
Coordinate Representation
Abscissa Resolution: ___(39)___
Ordinate Resolution: ___(40)___
Planar Distance Units: meters
Geodetic Model
Horizontal Datum Name: ___(41)___
Ellipsoid Name: ___(42)___
Semi-major Axis: ___(43)___
Denominator of Flattening Ratio: ___(44)___

Entity and Attribute Information

Overview Description
Entity and Attribute Overview: Map Unit Delineations are either closed polygons, points, or line segments that may be dominated by a single soil or non-soil component plus allowable similar or dissimilar soils, or they can be geographic mixtures of groups of soils and/or non-soil areas.

The map unit symbol uniquely identifies each delineated map unit. Each symbol is linked to a map unit name. The map unit symbol in the spatial map data is linked to related tabular attribute data in the Map Unit Record tables via the *mukey* data element. The map unit symbols are not carried within the modified Digital Line Graph file; however, they are made available in a companion attribute file. The attribute file links the minor codes in the Digital Line Graph files to the map unit symbols.

Map Unit Delineations are described by the Map Unit Record database. This attribute database gives the proportionate extent of the mapunit components and the properties for each component. The database contains both estimated and measured data on the physical and chemical soil properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range, and wildlife uses of the soil. The Map Unit Record database consists of the following relational tables:

(Names in parentheses are the database table names)

Component (component)
Component Canopy Cover (cocanopycover)
Component Crop Yield (cocropyld)
Component Diagnostic Features (codiagfeatures)
Component Ecological Classification (coecoclass)
Component Erosion Accelerated (coerosionacc)
Component Existing Plants (coeplants)
Component Forest Productivity (coforprod)
Component Forest Productivity - Other (coforprodo)
Component Geomorphic Description (cogeomordesc)
Component Hydric Criteria (cohydriccriteria)
Component Interpretation (cointerp)
Component Microrelief Surface Morphometry (cosurfmorphmr)
Component Month (comonth)
Component Parent Material (copm)
Component Parent Material Group (copmgrp)
Component Potential Windbreak (copwindbreak)
Component Restrictions (corestrictions)
Component Slope Shape Surface Morphometry (cosurfmorphss)
Component Soil Moisture (cosoilmoist)
Component Soil Temperature (cosoiltemp)
Component Surface Fragments (cosurffrags)
Component Taxonomic Family Mineralogy (cotaxfmmin)
Component Taxonomic Family Other Criteria (cotxfmother)
Component Taxonomic Moisture Class (cotaxmoistcl)
Component Text (cotext)
Component Three Dimensional Surface Morphometry (cosurfmorphgc)
Component Trees To Manage (cotreestomng)
Component Two Dimensional Surface Morphometry (cosurfmorphpp)
Distribution Interp Metadata (distinterpmd)
Distribution Legend Metadata (distlegendmd)
Distribution Metadata (distmd)
Domain Detail Static Metadata (mdstatdomdet)
Domain Master Static Metadata (mdstatdommas)
Horizon (chorizon)
Horizon AASHTO (chaashto)
Horizon Consistence (chconsistence)
Horizon Designation Suffix (chdesgnsuffix)
Horizon Fragments (chfrags)
Horizon Pores (chpores)
Horizon Structure (chstruct)
Horizon Structure Group (chstructgrp)
Horizon Text (chtext)
Horizon Texture (chtexture)
Horizon Texture Group (chtexturegrp)
Horizon Texture Modifier (chtexturemod)
Horizon Unified (chunified)
Index Detail Static Metadata (mdstatidxdet)
Index Master Static Metadata (mdstatidxmas)

Legend (legend)
Legend Area Overlap (laoverlap)
Legend Text (legendtext)
Mapunit (mapunit)
Mapunit Aggregated Attribute (muaggatt)
Mapunit Area Overlap (muaoverlap)
Mapunit Crop Yield (mucropyld)
Mapunit Text (mutext) Relationship
Detail Static Metadata (mdstatrshipdet)
Relationship Master Static Metadata (mdstatrshipmas)
Table Column Static Metadata (mdstattabcols)
Table Static Metadata (mdstattabs)

Additional metadata related to this database is available at the following website:
http://nasis.nrcs.usda.gov/documents/metadata/ssurgov2_0/

Special features are described in the feature table. It includes a feature label, feature name, and feature definition for each special and ad hoc feature in the survey area.

Entity and Attribute Detail Citation

U.S. Department of Agriculture. 1999. Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Soil Surv. Staff. Natural Resources Conservation Service. U.S. Dep. Agric. Handb. 436.

U.S. Department of Agriculture. 1998. Keys to Soil Taxonomy. Soil Surv. Staff, Natural Resources Conservation Service.

U.S. Department of Agriculture. National Soil Survey Handbook, title 430-VI. Soil Surv. Staff, Natural Resources Conservation Service.

U.S. Department of Agriculture. 1993. Soil Survey Manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18.

U.S. Department of Agriculture. 1994. Soil Survey Geographic (SSURGO) Data Base: Data use information. Soil Conserv. Serv.

U.S. Department of Agriculture. National Soil Information System (NASIS). Natural Resources Conservation Service.

Detail Description

Entity Type

Entity Type Label: Special Soil Features

Entity Type Definition: Special Soil Features represent soil, nonsoil, or landform features that are not otherwise digitized as soil delineations (area, line, and point features).

Entity Type Definition Source: U.S. Department of Agriculture. 1993. Soil Survey Manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18.

Attribute

Attribute Label: Special Soil Features Codes

Attribute Definition: Special Soil Features Codes represent specific Special Soil Features. These features are identified with a major code, a minor code, and a descriptive label. The codes and label are assigned to the point or line assigned to represent the feature on published maps.

Attribute Definition Source: U.S. Department of Agriculture. 1993. Soil Survey Manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18; U.S. Department of Agriculture. National Soil Survey Handbook, title 430-VI, part 647. Nat. Res. Conserv. Serv.

Attribute Domain Values
Codeset Name: Classification and Correlation of the Soils of _____(45)_____

Codeset Source: U.S. Department of Agriculture, Natural Resources Conservation Service

Distribution Information

Distributor
Contact Organization Primary
Contact Organization: U.S. Department of Agriculture, Natural Resources Conservation Service, National Cartography and Geospatial Center
Contact Address
Address Type: mailing address
Address: P.O. Box 6567
City: Fort Worth
State or Province: Texas
Postal Zone: 76115-0567
Contact Voice Telephone: 800 672 5559
Contact Facsimile Telephone: 817 509 3469

Resource Description: ______(46)______ SSURGO

Distribution Liability: Although these data have been processed successfully on a computer system at the U.S. Department of Agriculture, no warranty expressed or implied is made by the Agency regarding the utility of the data on any other system, nor shall the act of distribution constitute any such warranty. The U.S. Department of Agriculture will warrant the delivery of this product in computer readable format, and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer input peripherals, or when the physical medium is delivered in damaged condition. Request for adjustment of credit must be made within 90 days from the date of this shipment from the ordering site.

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Standard Order Process
Digital Form
Digital Transfer Information

Format Name: DLG
Format Version Date:___(47)___
Format Specification: Optional
Format Content Information: spatial and keys
Transfer Size: ___(48)___
Digital Transfer Option
Offline Option
Offline Media: CD-ROM
Recording Format: ISO 9660 Level 1
Digital Form
Digital Transfer Information
Format Name: ASCII
Format Content Information: keys and attributes
Transfer Size: ___(49)___
Digital Transfer Option
Offline Option
Offline Media: CD-ROM
Recording Format: ISO 9660 Level 1

Fees: The charge is $50 for a CD-ROM that contains one or more data sets. A data set is one soil survey area in (50) quadrangle format and includes both spatial and attribute data.

Ordering Instructions: Call or write to organizations listed under Distributor. Spatial line data and locations of special feature symbols are in DLG-3 optional format. Digital line graph files contain major and minor code pairs in area and line records. A conversion legend is provided for each digital line graph file. Soil map symbols and special feature labels are available in a companion ASCII attribute file. The Map Unit Interpretations Record attribute soil data are available in variable length, tab delimited, ASCII file format.

Turnaround: 10 working days

Metadata Reference Information

Metadata Date: ___(51)___
Metadata Review Date: ___(52)___
Metadata Contact
Contact Organization Primary
Contact Organization: U.S. Department of Agriculture, Natural Resources Conservation Service
Contact Position: State Soil Scientist
Contract Address
Address Type: mailing address
Address: ___________(53)___________
City: __________(54)___________
State or Province: __(55)__
Postal Code: __(56)__
Contact Voice Telephone: __________(57)__________
Contact Facsimile Telephone: __________(58)__________
Metadata Standard Name: Content Standards for Digital Geospatial Metadata
Metadata Standard Version: ___(59)___

Explanation of Template Metadata Numbered Elements

[Unless otherwise noted, all references refer to Federal Geographic Data Committee. 1998. Content standards for digital geospatial metadata. Federal Geographic Data Committee. Washington, DC.]

Numbers in Identification Information section

1 Publication Date - the date when the data set is published or otherwise made available for release. Enter the year the data are submitted for archiving and distribution. Enter the year in the date format YYYY. Example is Publication Date: 1994. Reference is from p. 53, sec. 8.2.

2 Title - the name by which the data set is known. Enter the complete name of the soil survey area as defined in the memorandum of understanding. Example is Polk County, Iowa. Reference is from p. 53, sec. 8.4.

3 Quadrangle Format - Enter either 7.5 quadrangle format or 3.75 quadrangle format.

4 Calendar Date - the year. Enter the year the data set is submitted for archiving and distribution. This entry is the same as the one from item 1. Enter the year in the date format YYYY. Example is Calendar Date: 1994. Reference is from p. 56, sec. 9.1.1.

Bounding Coordinates - the limits of coverage of a data set expressed by latitude and longitude values in the order western-most, eastern-most, northern-most, and southern-most. The bounding coordinates are for the soil survey area.

5 West Bounding Coordinate - western-most coordinate of the limit of coverage expressed in longitude. Enter the coordinate in decimal degrees. Example is West Bounding Coordinate: -93.750. Reference is from p. 5.

6 East Bounding Coordinate - eastern-most coordinate of the limit of coverage expressed in longitude. Enter the coordinate in decimal degrees. Example is East Bounding Coordinate: -93.250. Reference is from p. 5.

7 North Bounding Coordinate - northern-most coordinate of the limit of coverage expressed in latitude. Enter the coordinate in decimal degrees. Example is North Bounding Coordinate: 41.750. Reference is from p. 5.

8 South Bounding Coordinate - southern-most coordinate of the limit of coverage expressed in latitude. Enter the coordinate in decimal degrees. Example is South Bounding Coordinate: 41.375. Reference is from p. 5.

9 Place Keyword - the name of the state that the data set is in. Enter multiple states as separate entries. Reference is from p. 7. Example:

Place Keyword: Nevada
Place Keyword: Utah

10 Place Keyword - the name of the county that the data set is in. Enter multiple counties as separate entries. Reference is from p. 7. Example:

Place Keyword: Rains County
Place Keyword: Hopkins County

11 Place Keyword - the name of the quadrangle in the data set. Enter the USGS quadrangle name from the National Topographic Map Names database. The quadrangle numbers are available from the SSURGO Support Section, National Cartography and Geospatial Center. The quadrangle names are also in the Soil Survey Schedule quadnames table that resides as a part of the State Soil Survey Database in the NRCS state office. Enter all quadrangles that make up the soil survey area and enter each as a separate entry. Reference is from p. 7. Example:

Place Keyword: Pleasantville Quadrangle (s4109338)
Place Keyword: Hartford Quadrangle (s4109337)

12 Address - an address line for the address. Example is Address: 210 Walnut Street, Suite 693. Reference is from p. 59, sec. 10.4.2.

13 City - the city of the address. Example is City: Des Moines. Reference is from p. 59, sec. 10.4.3.

14 State or Province - the state or province of the address. Example is State or Province: Iowa. Reference is from p. 59, sec. 10.4.4.

15 Postal Code - the ZIP or other postal code of the address. Example is Postal Code: 50309-2180. Reference is from p. 59, sec. 10.4.5.

16 Contact Voice Telephone - the telephone number by which individuals can speak to the organization or individual. Example is Contact Voice Telephone: 402 437 5499. Reference is from p. 59, sec. 10.5.

17 Contact Facsimile Telephone - the telephone number of a facsimile machine of the organization or individual. Example is Contact Facsimile Telephone: 402 437 5336. Reference is from p. 60, sec. 10.7.

18 Originator - the name of an organization that developed the data set. This is the name from the published document. Example is Originator: Natural Resources Conservation Service or Originator: Soil Conservation Service. Reference is from p. 53, sec. 8.1.

19 Publication Date - the date when the data set is published or otherwise made available for release. Enter the year the data is submitted for archiving and distribution. Enter the year in the date format YYYY. Example is Publication Date: 1994. Reference is from p. 53, sec. 8.2.

20 Title - the name by which the data set is known. Enter the complete name of the soil survey area as defined in the memorandum of understanding. Example is Polk County, Iowa. Reference is from p. 53, sec. 8.4.

20a Edge Match Statements - Edge matching of digital data is described in terms of accuracy of matching of feature edges, feature labels, and descriptive attributes between quadrangles or data sets. In SSURGO, all three are required to match between adjacent quadrangles within the survey. Only the soil survey boundaries are required to match between surveys. Examples of edge match statements for adjacent soil surveys:

The quadrangles in this soil survey are not edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in the Alpha Soil Survey, but are not edge matched to those in the Beta or Gamma Soil surveys.

Feature edges and descriptive attributes of quadrangles in this soil survey are matched to those in adjacent soil surveys. Feature labels do not match.

21 Minimum Size Delineation - the minimum size of map unit delineation as defined in the memorandum of understanding for the data set. Enter the size in acres. Example is 2.

Numbers in Data Quality Information section

The Spatial Data Transfer Standard Data Quality Report consists of five parts covering lineage, positional accuracy, attribute accuracy, logical consistency, and completeness. The Data Quality Report is presented in part 1, section 3 of the Spatial Data Transfer Standard.

22 Originator - the name of an organization or individual that developed the data set. Example is Originator: U.S. Geological Survey. Reference is from p. 53, sec. 8.1.

23 Publication Date - the date when the data set is published or otherwise made available for release. Enter the year in the date format YYYY. Example is Publication Date: 1983. Reference is from p. 53, sec. 8.2.

24 Title - the name by which the data set is known. Example is Title: Soil Survey of Polk County, Iowa. Reference is from p. 53, sec. 8.4.

25 Geospatial Data Presentation Form - the mode in which the geospatial data is presented. Example is Geospatial Data Presentation Form: Topographic quadrangle map. Reference is from p. 54, sec. 8.6.

26 Publication Place - the name of the city and state where the data set was published or released. Example is Publication Place: Reston, Virginia. Reference is from p. 54, sec. 8.8.1.

27 Publisher - the name of the individual or organization that published the data set. Example is Publisher: U.S. Geological Survey. Reference is from p. 54 sec. 8.8.2.

28 Source Scale Denominator - the denominator of the representative fraction on a map. Example is Source Scale Denominator: 12000. Reference is from p. 13, sec. 2.5.1.2.

29 Type of Source Media - the medium of the source data set. Example is Type of Source Media: stable-base material. Reference is from p. 13, sec. 2.5.1.3.

Single Date/Time - this is a single element and must be followed with the element Calendar Date.

30 Calendar Date - the year. Enter the year in the date format YYYY. Example is Calendar Date: 1960. Reference is from p. 56, sec. 9.1.1.

Range of Dates/Times - this is a compound element and must be followed with the elements Beginning Date and Ending Date.

30a Beginning Date - the first year of the event. Enter the year in the date format YYYY. Example is Beginning Date: 1989. Reference is from p. 56, sec. 9.3.1.

30b Ending Date - the last year for the event. Enter the year in the date format YYYY. Example is Ending Date: 1992. Reference is from p. 57, sec. 9.3.3.

31 Source Currentness Reference - the basis on which the source time period of content information of the source data set is determined. Example is Source Currentness Reference: publication date. Reference is from p. 14, sec. 2.5.1.4.1.

32 Source Citation Abbreviation - the short-form alias for the Source Citation. For example, Source Citation Abbreviation: NRCS1. Reference is from p.14, sec. 2.5.1.5.

33 Source Contribution - brief statement identifying the information contributed by the source to the data set. Example is Source Contribution: digitizing source. Reference is from p. 14, sec. 2.5.1.6.

34 Process Description - an explanation of the event and related parameters or tolerances. Reference is from p. 14, sec. 2.5.2.1.

35 Process Date - the date when the event was completed. Enter the year in the date format YYYY. Example is Process Date: 1993. Reference is from p. 14, sec. 2.5.2.3.

36 Source Used Citation Abbreviation - The Source Citation Abbreviation of a data set used in the processing step. For example, Source Used Citation Abbreviation: NRCS1. Reference is from p. 14, sec. 2.5.2.2.

Numbers in Spatial Reference Information section

37 UTM Zone Number - identifier for the UTM zone. If the soil survey area is covered by multiple zones, enter each as a separate entry. Reference is from p. 30, sec. 4.1.2.2.2.1. Example:
UTM Zone Number: 15
UTM Zone Number: 16

38 Longitude of Central Meridian - the line of longitude at the center of a map projection generally used as the basis for constructing the projection. Each UTM zone covers 6 degrees in longitude. Example is UTM zone 13 that begins at -102 degrees and ends at -108 degrees. The longitude of central meridian is the center of the zone, or -105. Reference is from p. 27, sec. 4.1.2.1.23.2.

39 Abscissa Resolution - the (nominal) minimum distance between the x or column values of two adjacent points, expressed in Planar Distance Units of measure. The resolution is dependent upon the source map scale. Example is Abscissa Resolution: .305. Reference is from p. 32, sec. 4.1.2.4.2.1.

Scale	Abscissa Resolution
1:12,000	.305
1:15,840	.402
1:20,000	.51
1:24,000	.61

40 Ordinate Resolution - the (nominal) minimum distance between the y or row values of two adjacent points, expressed in Planar Distance Units of measure. The resolution is dependent upon the source map scale. Example is Ordinate Resolution: .305. Reference is p. 32, sec. 4.1.2.4.2.2.

Scale	Ordinate Resolution
1:12,000	.305
1:15,840	.402
1:20,000	.51
1:24,000	.61

41 Horizontal Datum Name - the identification given to the reference system used for defining the coordinates of points. Example is Horizontal Datum Name: North American Datum of 1983 or Horizontal Datum Name: North American Datum of 1927. Reference is from p. 34, sec. 4.1.4.1.

42 Ellipsoid Name - identification given to established representations of the Earth‹s shape. Example is Ellipsoid Name: Geodetic Reference System 80. Reference is from p. 34, sec. 4.1.4.2.

Datum Name	Ellipsoid Name
North American Datum of 1983	Geodetic Reference System 80
North American Datum of 1927	Clarke 1866

43 Semi-major Axis - radius of the equatorial axis of the ellipsoid. Example is Semi-major Axis: 6378137.0. Reference is from p. 34, sec. 4.1.4.3.

Ellipsoid Name	Semi-major Axis
Geodetic Reference System 80	6378137.0
Clarke 1866	6378206.4

44 Denominator of Flattening Ratio - the denominator of the ratio of the difference between the equatorial and polar radii of the ellipsoid when the numerator is set to 1. Example is Denominator of Flattening Ratio: 298.257. Reference is from p. 34, sec. 4.1.4.4.

Denominator of Ellipsoid Name	Flattening Ratio
Geodetic Reference System 80	298.257
Clarke 1866	294.98

45 Codeset Name - the name of the soil survey area as it appears in the title of the soil classification and correlation document. Example is Polk County, Iowa.

Numbers in Distribution Information section

46 Resource Description - the identifier by which the distributor knows the data set. For example, Resource Description: Polk Country, Iowa SSURGO. Reference is from p. 43, sec. 6.2.

47 Format Version Date - the date of the version of the format. The date is in line 1 of the DLG header. Enter the date in the format YYYYMMDD. For example, Format Version Date: 19920508. Reference is from p. 45, sec. 6.4.2.1.3

48 Transfer Size - the size, or estimated size, of the transferred data set in megabytes. This is the sum for all DLGs in the data set. Example is Transfer Size: 14.4. Reference is from p. 45, sec. 6.4.2.1.7.

49 Transfer Size - the size, or estimated size, of the transferred data set in megabytes. This is the sum for all attribute tables in the data set. Example is Transfer Size: 0.4. Reference is from p. 45, sec. 6.4.2.1.7.

50 Quadrangle Format - Enter 7.5 or 3.75.

Numbers in Metadata Reference Information section

51 Metadata Date - the date that the metadata were created or last updated. Enter the date in the format YYYYMMDD. For example, Metadata Date: 19940311. Reference is from p. 50, sec. 7.1.

52 Metadata Review Date - the date of the latest review of the metadata entry. This is the date of the NCG review. The date is entered in the format YYYYMMDD. For example, Metadata Review Date: 19940329. Reference is from p. 50, sec. 7.2

53 Address - an address line for the address. Example is Address: 210 Walnut Street, Suite 693. Reference is from p. 59, sec. 10.4.2.

54 City - the city of the address. Example is City: Des Moines. Reference is from p. 59, sec. 10.4.3.

55 State or Province - the state or province of the address. Example is State or Province: Iowa. Reference is from p. 59, sec. 10.4.4.

56 Postal Code - the ZIP or other postal code of the address. Example is Postal Code: 50309-2180. Reference is from p. 59, sec. 10.4.5.

57 Contact Voice Telephone - the telephone number by which individuals can speak to the organization or individual. Example is Contact Voice Telephone: 402 437 5499. Reference is from p. 59, sec. 10.5.

58 Contact Facsimile Telephone - the telephone number of a facsimile machine of the organization or individual. Example is Contact Facsimile Telephone: 402 437 5336. Reference is from p. 60, sec. 10.7.

59 Metadata Standard Version - identification of the version of the metadata standard used to document the data set. Enter the date in the format: YYYYMMDD. For example, the current Metadata Standard Version is: 1998. Reference is from p. 51, sec. 7.6.

Part 649 - LAND RESOURCE REGIONS AND MAJOR LAND RESOURCE AREAS

CONTENTS

Part 649 - LAND RESOURCE REGIONS AND MAJOR LAND RESOURCE AREAS

649.00 Definition.

Land resource regions and major land resource areas are separated on the basis of significant differences in use and management of the soils as reflected in land use patterns. These regions and areas represent nearly homogeneous areas of soil, climate, land use, water resources, elevation, topography, and potential natural vegetation.

(a) Land resource regions (LRR) are geographically associated groups of major land resource areas and consist mainly of areas that have very broadly related patterns of soil, climate, water resources, and land use. Land resource regions are delineated only on small scale national maps (1:7,500,000; 1:10,000,000; or smaller) and are most useful for national and regional program planning. Land resource regions are unique, continuous delineations, which approximate physiographic regions on small scale national maps.

(b) Major land resource areas (MLRA) are based upon aggregations of geographically associated land resource units and identify nearly homogeneous areas of land use, elevation, topography, climate, water resources, potential natural vegetation, and soils. Major land resource area boundaries reflect an appropriate generalization of land resource unit boundaries (as derived from state soil geographic database map unit boundaries). The approximate minimum size of a major land resource area that may be delineated is 580,644 hectares, or 1,434,803 acres. This minimum delineation is represented at the official major land resource area map scale of 1:7,500,000 by an area approximately 1 cm by 1 cm (0.4 inch by 0.4 inch). Minimum linear delineations are at least 0.3 cm (0.1 inch) in width and 2.5 cm (1 inch) in length. The Pacific and Caribbean Islands, which have land areas less than 580,644 hectares (1,434,803 acres) in size are excluded from the minimum delineation rule. Large existing major land resource areas may be subdivided to create more homogeneous areas as needed, provided that cartographic criteria regarding minimum delineations are met. The descriptions of the map units on major land resource area maps emphasize land use and water resource management. Generally, a major land resource area occupies one continuous delineation; but it may occupy several separate ones. Major land resource areas are most useful for statewide agricultural planning and have value for interstate, regional, and national planning.

(c) Land resource units (LRU) are derived from the aggregation of map units of the state soil geographic (STATSGO) database. This is possible because each state soil geographic database map unit has a major land resource area designation in the state soil geographic database attribute file. The STATSGO-GRASS Interface software is a useful geographic information system tool for generating the first draft of the land resource unit map from a state soil geographic database. Based on a shared 1:250,000 scale, map unit boundaries on land resource unit maps largely coincide with those in the state soil geographic database. Land use exceptions are described in part 649.05 of this handbook. Cartographic standards regarding the minimum size of delineations for land resource unit maps are equivalent to those for the state soil geographic database. Land resource units may occur as single delineations but commonly occur as several separate delineations. Land resource unit maps often depict areas that are cartographically too small to be delineated on the national major land resource area map at 1:7,500,000 scale. Therefore, land resource units are not shown on the national major land resource area map. Land resource units are shown only on state maps.

(d) USDA Agriculture Handbook No. 296, Land Resource Regions and Major Land Resource Areas of the United States (Soil Survey Staff, 1981), represents an assemblage of information currently available about the land for farming, ranching, forestry, engineering, recreational development, and other uses. This assemblage consists of the land resource region and major land resource area map and the supporting land resource region and major land resource area map unit descriptions. Such land resource information

(both analog and digital) is used at National, regional, and State levels:
- -- as a basis for making decisions about agricultural issues;
- -- as a framework for organizing and operating resource conservation programs;
- -- for the geographic organization of research and conservation needs and the data derived from these activities;
- -- for coordinating technical guides within and between states;
- -- for organizing, displaying, and using data in physical resource inventories; and
- -- for aggregating natural resource data.

649.01 Policy and Responsibilities.

(a) The MLRA office is responsible for:
- -- submitting suggested changes in land resource regions and major land resource areas to the National Soil Survey Center;
- -- obtaining concurrence in suggested changes from other disciplines and states that share the land resource region or major land resource area;
- -- maintaining the boundary, description, and documentation for each major land resource area that is assigned to the MLRA office (as given in Exhibit 649-1); and
- -- providing the National Soil Survey Center with a small scale copy of the major land resource area map for the responsible area.

(b) The National Soil Survey Center is responsible for keeping current the land resource region and major land resource area maps and descriptions. It periodically issues a revised edition of Agricultural Handbook 296, which provides supporting attributes to these map products.

649.02 Land Resource Region and Major Land Resource Area Map Unit Descriptions.

The land resource region descriptions are summaries of the important characteristics of the major land resource areas. They are maintained by the National Soil Survey Center.

The dominant physical characteristics of major land resource areas are described under specified headings. Significant exceptions to these characteristics are described separately.

(a) Land use.
The extent of the land used for cropland, pasture, range, forests, industrial and urban developments, and other special purposes is indicated. The figures given are for the entire resource area unless stated otherwise. Also included is a list of the principal crops grown and the type of farming practiced. (See Exhibit 649-2, reference 3.) If significant, the relative extent of the federally owned land is indicated.

(b) Elevation and topography.
The typical range in elevation, expressed in meters above sea level, is given for the area as a whole. The dominant range for significant components is also given. The topography of the area and the geologic, geomorphic, and other natural and cultural features characteristic of different parts of the resource area are described. (See Exhibit 649-2, reference 1.)

(c) Climate.
A range of mean annual precipitation for the driest and the wettest parts of the major land resource area and a range of the seasonal distribution of precipitation are given. Also given are a range of the mean annual air temperature and the average frost-free period characteristic of different parts of the major land resource area. The mean annual precipitation, the mean annual air temperature, and the average frost-free period should be referenced according to weather station and to a specific collection of 30-year normals (such as from 1961 to 1990), as summarized by the NOAA staff in Climatography of the United States No. 81. (See Exhibit 649-2, references 4, 5, 6, and 7.) These data are available from the Natural Resources Conservation Service Climate Data Access Facility which is located Portland, Oregon.

(d) Water resources.
Information is given concerning surface stream flow, ground water, and the source of water for municipal use and irrigation. Also, dependency upon neighboring major land resource areas for water supply or ability to provide water to neighboring major land resource areas is described. The extent and number of irrigation districts in the major land resource area are given where pertinent. Also, the 8-digit U.S. Geological Survey Hydrologic Units are listed by relative extent.

(e) Soils.
Soils are identified according to the principal taxonomic great groups as referenced in the state

soil geographic database. Soil series that are representative of each great group are listed, and the relationship of soils to landscape position is described.

(f) Potential natural vegetation. Where pertinent, the most common plant and forest communities are identified by dominant species using common names. (See Exhibit 649-2, references 2 and 3.) Ecoregions that occur in the major land resource area are listed by relative extent. (See Exhibit 649-2, reference 8.)

649.03 Land Resource Region and Major Land Resource Area Map Unit Names and Symbols.

Traditionally, the names of land resource regions and major land resource areas reflect certain unique relationships to agriculture or forestry, but there is no set standard for names or terms.

(a) The names of land resource regions are combinations of names of broad physiographic provinces and predominant land use, for example, Western Range and Irrigated Region.

(b) The names of major land resource areas commonly use the names of associated physiographic areas, landforms, and "natural geographic" areas, for example, Northern Coastal Plain.

(c) The symbols for land resource regions are designated by capital letters, for example, U - Florida Subtropical Fruit, Truck Crop, and Range Region.

(d) The symbols for major land resource areas are designated by an Arabic numeral or by an Arabic numeral and a letter if previously established areas have been subdivided to provide for more homogeneous areas, for example, 14 - Central California Coastal Valleys or 63A - Northern Rolling Pierre Shale Plains.

649.04 Procedures for Establishing and Revising Land Resource Regions and Major Land Resource Areas.

Land resource region and major land resource area analog maps have traditionally been reasonably stable. However, a reevaluation of land resource region and major land resource area map unit concepts is in process. This is due to efforts to update soil surveys by major land resource area and the introduction of a new digital map product (state soil geographic database) as the basic major land resource area building block. As a result, there is a need to define new major land resource areas or revise previously accepted major land resource area delineations (and consequently associated land resource regions). The procedures used to accomplish the changes are as follows:

(a) If a state desires to change the existing land resource region or major land resource area map, it submits changes to the MLRA office which coordinates the suggested changes in existing major land resource areas with the National Soil Survey Center as well as with all National Cooperative Soil Survey cooperators.

(b) The MLRA offices or areas that share the major land resource area or land resource region ensure that the maps displaying these areas are joined and coordinated across boundaries. The responsibility for maintaining individual major land resource areas is assigned to each MLRA office, as listed in Exhibit 649-1.

(c) The MLRA office submits the following complete documentation to the National Soil Survey Center:

- -- state land resource unit map that supports the suggested changes to the major land resource area. This is a computer generated film proof plot that shows land resource unit boundaries and symbols in black with an overlay showing the proposed major land resource area boundaries and symbols in red. For the purpose of hard copy presentation, this map is made at a scale of 1:500,000.
- -- draft major land resource area map with suggested change(s). This is a 1:7,500,000 scale map generated from the most current approved digital version of the major land resource area map. This map consists of a computer generated film proof plot showing proposed major land resource area boundaries and symbols in red and existing major land resource area boundaries and symbols in black,
- -- draft major land resource area descriptions,
- -- documentation stating reasons for the suggested change(s), and
- -- letters from the MLRA offices of areas that share the major land resource area. These letters show concurrence on the change(s)

and document a correct join if the change(s) affect the areas that share the major land resource area.

Note: Submission of a data set of the GRASS geographic information system showing the state coverage that contains only labeled land resource unit and proposed major land resource area vectors is presently optional but will be the preferred means of transmittal in the future.

(d) Approved changes are digitally incorporated into the existing major land resource area and land resource region map and into the associated major land resource area map unit descriptions by the National Soil Survey Center. A 1:7,500,000 scale proof plot and major land resource area map unit descriptions that reflect the new revision are sent to the originating MLRA office to document the changes made at the National level. All documentation supporting the approved change is archived by the National Soil Survey Center.

649.05 Land Resource Unit Maps of States.

(a) Definition.
Land resource units define major land resource areas based on significant statewide differences in climate, water resources, land use, potential natural vegetation, or other natural resource conditions that contribute to significant differences in use and management of the units.

Major land resource area boundaries on state maps are identical and coincide with the boundaries on the national map. However, so that the state needs to express the major land resource area concept at a larger scale can be accommodated, the major land resource area map units are disaggregated or broken down into land resource units. Land resource unit boundaries generally coincide with state soil geographic database map unit boundaries with the following exception. State soil geographic database map units may be subdivided into land resource units if there are significant and mappable differences in water resources, land use, or type of farming. Due to differences in scale, most major land resource area and land resource unit boundaries are not exactly the same. However, major land resource area boundaries should reflect an appropriate generalization of land resource unit boundaries, just as land resource region boundaries should reflect major land resource area boundaries.

(b) Prescribed scale of state land resource unit maps.
The prescribed scale for state land resource unit map management generally is 1:250,000. In Alaska, land resource units are managed at a scale of 1:1,000,000. Land resource unit maps are derived from the state soil geographic database and serve as a companion geographic information system (GIS) data set. Land resource unit maps provide sufficient detail to permit their use for general planning of land resources at the State level. For the purpose of hard copy presentation, state land resource unit maps are made at a scale of 1:500,000.

(c) Land resource unit map unit names and symbols.
The conventions used in giving names and symbols to land resource units are based on the major land resource area name and symbol. The land resource unit symbol uses the major land resource area symbol followed by a hyphen, an Arabic number, and the state alpha FIPS code. For example, 144A-1NY would represent the first land resource unit in major land resource area 144A in New York. This land resource unit map unit name would be New England and Eastern New York Upland, Southern Part, LRU-1NY. Land resource unit map unit names and symbols are specific to each state. Therefore, land resource units may not be presently referenced in place of major land resource areas on national data sets, such as the National Resource Inventory or the range site data set, which require correlation across state boundaries. Because of the need to coordinate field office technical guides across state boundaries, land resource units, unless they are coordinated with adjoining states, have limited application for this purpose.

(d) The procedure for establishing land resource units.
The state conservationist establishes the procedures for developing and maintaining land resource unit boundaries and descriptions. Procedures and criteria are similar to those for establishing major land resource areas at the National level but are at a larger scale.

Exhibit 649-1 A List of Major Land Resource Areas Assigned to Each MLRA Office.

MO	Location	First Approximation of MLRA assignment to MLRA Soil Survey Regions
1	Portland. OR	1,2,3,6,7,8,9,10,10A*,11,11A*,11B*,12,13
2	Davis, CA	4,5,14,15,16,17,18,19,20,22,30,31,157,158,161,164,166,190*,191*, 192*,193*,194*,195*,196*,197*,198*,199*,200*,201*,202*,203*
3	Reno, NV	21,23,24,25,26,27,28A,28B,29
4	Bozeman, MT	32,33,43,44,46
5	Salina, KS	65,67,69,71,72,73,74,75,76,79,106,112
6	Lakewood, CO	34,47,48A,48B,49,49A*,49B*,51
7	Bismarck, ND	52,53A,53B,53C,54,55A,55B,55C,56,58A,58B,58C,58D,60A,60B,61, 62,63A,63B,64,66
8	Phoenix, AZ	31,35,36,36A*,36B*,36C*,37,38,39,39A*,39B*,39C*,40,41, 42,42A,42B,42C
9	Temple, TX	70,70A*,70B*,70C*70D*,70E*,77,77A*,77B*,77C*,77D*,77E*, 78,78A*,78B*,78C*,78D*,80A,80B,81,81A*,81B*,81C*,81D*, 82,82A*,82B*,83A,83B,83C,83D,84A,84B,84C,85,85A*,85B*, 86,86A*,86B*,87,87A*,87B*,150A,150B, 151,152B
10	St Paul, MN	57,88,90,91,92,93,94B,102A,102B,102C*,103,104,105, 107,109. 94A,108,108A*,108B*,108C*, and 108D*(shared with MO11)
11	Indianapolis, IN	95A,95B,96,97,98,99,,110,111,113,114,115,115A*,115B*,115C*. 94A,108,108A*,108B*,108C*, and 108D*(shared with MO10)
12	Amherst, MA	100,101,139,140,141,142,143,144A,144B,145,146
13	Morgantown, WV	120,121,122,123,124,125,126,127,128,129,130,147,148
14	Raleigh, NC	136,137,149A,149B,153A,153B,153C,153D*. 133A(shared with MO15).
15	Auburn, AL	138,152A,154,155,156A,156B,270*,271*,272*,273* 133A(shared with MO14). 135(shared with MO16).
16	Little Rock, AR	116A,116B,117,118,118A*,118B*,119,131,133B,134. 135(shared with MO15).
17	Anchorage, AK	168,169,170,171,172,173,174,175,176,177,178,179,180,181,182

*Proposed MLRA's are those delineations which may or may not have descriptions and need to be to created from official MLRA delineations through the regionalization of STATSGO. **Note**: All existing official MLRA's (circa 1984) and their descriptions will be regionalized in STATSGO and reviewed in a state-wide forum of participants within the context of Interagency Ecological Mapping.

Exhibit 649-2 Recommended References.
(Available from the National Soil Survey Center)

(1) Jensen, S. 1992. One-Half Kilometer DEM coverage for the U.S. USGS. EROS Data Center, Sioux Falls, SD

(2) Kuchler, A.W. 1985 (revised). Potential Natural Vegetation. *In* National Atlas of the United States of America. Dept. of the Int., U.S. Geol. Surv.

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Part 651 – ADVANCE SOIL SURVEY INFORMATION

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Part 651 – ADVANCE SOIL SURVEY INFORMATION

651.00 Definition and Purpose.

(a) Advance soil survey information is information that has been gathered but is not yet published to the Soil Data Mart. The purpose of providing advance soil survey information is to furnish users with soil maps, interpretations, and other data prior to final correlation of the data.

(b) Soil data posted to the Soil Data Mart is official soil information, typically correlated, but nevertheless certified for use by the State Soil Scientist in participation with the State Technical Guide Committee for USDA programs.

(c) Interim reports are considered obsolete with the advent of the Soil Data Mart and Web Soil Survey. Interim reports were defined as reports that were prepared and produced after the final correlation memorandum was signed and before the soil survey is published.

Progressively correlated soil information is now publicly accessed through the Soil Data Mart and Web Soil Survey prior to the completion of the soil survey.

651.01 Policy and Responsibilities.

(a) Advance soil survey information for private lands is available for review by the public in Natural Resources Conservation Service (NRCS) offices and in the appropriate agency for public lands. Some of these data may be posted to the Soil Data Mart at the discretion of the State Soil Scientist or agency.

(b) The party requesting the data normally bears the cost of preparation or reproduction, or both. The state conservationist or the appropriate head of the lead agency is responsible for determining how to finance and where to reproduce advance soil survey information.

651.02 General.

(a) The users requesting advance soil information generally are of two types: (1) those who are cooperators in conducting the soil survey and have signed the memorandum of understanding and (2) those who are not.

(b) Advance soil survey information is part of the technical assistance provided to conservation district cooperators. Conservation district cooperators are entitled to this technical assistance as a result of memoranda of understanding other than the memorandum of understanding that is specific to a soil survey area. The NRCS General Manual, Title 180, Parts 401.22 and 401-40 through 401-42, provide more information. Soil survey information is encouraged to be correlated progressively and placed on the Soil Data Mart as it is updated or developed. Placing soil survey information onto the Soil Data Mart removes the information from the status of advance soil survey information.

(c) Interested individuals of either type can study and review copies of the field sheets, composite overlays, or digitized copies of field sheets and attribute data from which interpretations or conservation plans are prepared. They may purchase copies of these materials and copies of soil survey spatial and attribute databases according to procedures established in the state.

651.03 Restrictions.

(a) A soil map with interpretations that were prepared specifically for use in developing a conservation plan for a district cooperator may not be made available except under certain circumstances. The NRCS General Manual, Title 120, Part 408, and National Instruction 120-310, provide more information.

(b) Advance soil survey information requires special labeling. Part 651.05 of this section discusses the requirements for labeling field sheets. These requirements also apply to composite overlays and digitized products that are provided outside the Soil Data Mart and Web Soil Survey.

651.04 Providing Quality Assurance, Quality Control, and Review.

To ensure a quality product, map unit names, field sheets, composite overlays, digitized products, and interpretation tables and text are reviewed to ensure the information is legible and easily read and consistent with adjoining areas. An identification legend, a feature and special symbols legend, and supporting explanatory material must accompany all advance soil survey field sheets and digitized soil maps.

651.05 Labeling of Advance Soil Survey Information.

(a) Advance soil survey information is labeled with the names of the cooperating agencies; the United States Department of Agriculture, Natural Resources Conservation Service; the month and year it was prepared, and any necessary precautionary notes. These notes need not follow any specific format or be in finished form, but they must be legible. Part 607.02(b) provides more information on labeling field sheets. All field sheets in advance soil survey information are labeled "ADVANCE COPY SUBJECT TO CHANGE."

(b) The text of all advance soil information and the electronic products contain a statement that warns that the information is not official NRCS information. For example, "Information in this report is unofficial data subject to change upon completion, correlation, and publication to the Soil Data Mart; therefore, the user is cautioned that some map units may be discontinued, others combined, or the name of some changed and, as a result, soil suitability ratings and interpretations are likely to change. This information is not valid for USDA programs."

Part 655 - TECHNICAL SOIL SERVICES

CONTENTS

Part 655 - TECHNICAL SOIL SERVICES

655.00 Definition.

Technical soil services are the presentation and application of soil survey information to users. Soil scientists help users to understand the soil survey, to apply soil information to specific needs, and to integrate soil survey information with other resources and technology. Technical soil services include the derivation and application of soil information to meet USDA and NRCS policy and program needs. Technical soil services are cooperative efforts of the National Cooperative Soil Survey (NCSS).

655.01 Types of Service.

Technical soil services provide five basic types of service. The types of service are information services; technical policy and program services; planning services; site specific soil investigations, testing, interpretation, and evaluation; and expert services for judicial requests.

(a) Information services. Information services are the distribution and explanation of National Cooperative Soil Survey procedures and standards, including the technical content and use of soil survey products. They commonly provide and explain on-the-shelf NCSS products and materials and are part of agency responsibilities for public information. These services provide assistance to agencies, companies, groups, or individuals in written or oral form. Delivery of these services does not require a formal agreement. Activities, such as soils training sessions on the use of soil survey data for specific application, are part of information services.

Products that are developed by the Soil Survey Division target specific audiences. Alternative report formats provide options to meet the different need of each customer. Various reports from the National Soil Information System are examples. Custom interpretations are additional examples of products and information services for specific customers. A marketing plan helps to ensure that products meet customer expectations.

(b) Technical policy and program services. Technical policy and program services are services to Federal agencies, State or local units of government, or private groups or individuals that use technical soil survey information in their policy and programs. These services ensure that those government policies that support improved planning, management, or regulation of lands use current and official soil survey information. The Soil Data Mart provides access to the agency's official soil survey information which is the source of soil survey information in the Field Office Technical Guide. The Field Office Technical Guide is an interdisciplinary document. Formal agreements that include a general reference to technical soil services provide the operational authority to NRCS when it assists other agencies.

(c) Planning services. Planning services are the technical interpretation of soil survey information for the development of plans that include conservation practices and systems. Soil conservation district cooperators and USDA program participants are the primary recipients of these planning services. Recipients also include Federal agencies, State governments, or local governments. Planning services involve recommendations on specific tracts of land. Formal agreement with the soil conservation district as a cooperator or a formal agreement with the NRCS that includes specific reference to technical soil services provides the operational authority for the NRCS.

(d) Site-specific soil investigations, testing, interpretation, and evaluation. Site-specific soil investigations, testing, interpretation, and evaluations are services that support the design and installation of works and structures or the implementation of agricultural practices, or that test and evaluate research predictions. These technical soil services are part of NRCS technical assistance to individual cooperators or units of government that have signed agreements specifying the services. The intention of services to individual cooperators is usually to help apply a conservation plan. These are described in general terms in district agreements with NRCS. These services are very site specific and often result in design and practice specifications.

(e) Expert services for judicial requests. Expert services related to judicial requests are technical soil services that originate as a result of legal actions affecting Federal, State, or local governments involved with soil resource data. Agency policy requires agency advice and authority from NRCS management and USDA legal counsel before providing these services. Contact the NRCS state administrative officer if legal services are requested by any means. General Manual 360, part 415, subpart E, provides more information. Also refer to 7CFR1.210 and subsequent sections through 7CFR1.219 (also know as Subpart K).

655.02 Policy.

(a) NRCS technical soil services, except for information services, go to or through Federal, State, and local units of government with which there is a memorandum of understanding or a cooperative agreement.

(b) Provide onsite technical assistance to private individuals only though formal agreements with government entities, such as conservation districts, that specify the services. This assistance relates directly to NRCS programs, as defined in the conservation district memorandum of understanding.

655.03 Responsibilities.

Soil scientists provide technical soil services both within the framework of the soil survey program and as part of other programs.

(a) The responsibility of the resource soil scientist is to provide technical soil services for NRCS field offices. (Resource soil scientist is a generic term and applies more to the role than to the title.) These services are variable and individual in nature. Common activities of a resource soil scientist are:

- assessing the role of soils in the environment and the impact of soils on human activities and the impact of humans on soils;
- developing and maintaining the soils information in the Field Office Technical Guide;
- conducting onsite soil investigations and special soil-related studies for NRCS and other client agencies;
- providing soil consultative assistance to users of geographic information systems that are cosponsored by NRCS;
- serving as a member of interdisciplinary teams to address resource problems and the implementation of NRCS programs;
- training NRCS employees and the technical staffs of other agencies or groups in the use of soil survey information;
- participating in public awareness programs involving the soil survey and its uses;
- monitoring the availability of soil surveys and conducting evaluations of the surveys;
- collecting soil and site data on soil performance and behavior; and
- assisting with the development, testing, and verification of new soil interpretations.

(b) The responsibilities of the state soil scientist are:

- coordinating the development of local soil interpretations;
- providing for training in generating interpretations;
- providing leadership in developing state soil survey marketing plans;
- developing an overall technical soil services strategy in the state, including identification of needed services and potential clients, working agreements, memoranda of understanding, budgets, staffing plans, position descriptions, and locations for providing technical soil services;
- coordinating and communicating the technical soil services program objectives with all NRCS offices within the state;
- encouraging the development of interdisciplinary, multi-agency teams to address regional issues;
- providing statewide technical soil services to other state office disciplines and outside clients;
- providing training to potential users of soil survey information;
- providing technical guidance to resource soil scientists;
- coordinating research and application technology development among NCSS cooperators; and

- providing quality control of technical soil services and related activities, including the Field Office Technical Guide.

(c) The responsibilities of the National Soil Survey Center are:
- providing technical soil services to divisions at the NRCS National Headquarters;
- participating in interagency or multidisciplinary teams and task forces to address national concerns related to soils;
- providing technical soil services to other national government organizations;
- providing technology support for technical soil services; and
- coordinating research and application technology development among NCSS cooperators.

(d) The responsibilities of the National Technical Support Centers soil scientists are:
- providing direct assistance and technology transfer to states, and
- acquiring and developing new science and technology.

(e) The responsibilities of the National Headquarters soils staff are:
- implementing an outreach program for, and building alliances with, potential users of soil survey information.

(f) The responsibilities for cooperators in the NCSS are:
- outlined in the each Statewide Memorandum of Understanding.

655.04 Order 1 Soil Surveys.

(a) Definition and Purpose.
Definition: *Order 1 soil surveys are soil inventories produced for very intensive land uses that require detailed information about soils.*

Order 1 soil surveys are commonly use-specific soil inventories generally made on small tracts of land at a large scale (usually larger than 1:12000). The survey may use different tools and criteria for each specific purpose. An order 1 soil survey targets multiple soil properties for different applications. Thus, these site-specific mapping efforts are tailored for precision farming applications, for the review of subdivision and site plans, for management of bio-solids, or for other unique land uses that require detailed soils information.

Order 1 soil surveys are site-specific soil investigations. The Natural Resources Conservation Service infrequently conducts order 1 soil surveys and only with a signed agreement. The Natural Resources Conservation Service seldom publishes an order 1 soil survey. Exceptions are experiment stations and long term ecological sites.

Field procedures include observations within each soil map delineation. The placement of soil boundaries corresponds with changes in soil properties or surface configuration. Order 1 soil surveys can provide reliable information about soil properties that are near the surface or that require deep investigations. Information is gathered from detailed sampling. Soil descriptions, soil maps, and supporting information provide well-documented data for customers.

(b) Order 1 Soil Survey Standards.
Order 1 soil survey standards are operational procedures and criteria used to conduct order 1 soil surveys. These standards do not preclude the development of additional criteria.

(1) A soil map, a legend with map symbols and soil names, and soil map unit descriptions that address the soil properties are standards for order 1 soil surveys. The maps include the geographic location and size of the site, the date the soil map was produced, the surveyor's initials, and the map scale.

(2) Order 1 soil surveys require detailed soil pedon descriptions for all map unit components. Taxonomic placement of soil components is not required but may be helpful in the application of the data to other areas.

(3) Describe soil properties according to the procedures outlined in Chapter 3 of the Soil Survey Manual.

(4) Order 1 standards require field observation of the soils within all soil map delineations and of each soil boundary.

(5) Georeference all point data for transects and grid sampling.

(c) Work Plan.

Order 1 soil surveys begin with a work plan for the survey area. This plan includes the specific needs and purpose for the survey and other features agreed upon between the parties involved. The minimum work plan includes map scale, mapping base, field procedures, identification of map units, map labeling, use of special feature symbols, and the soil properties to be identified. Add other criteria as needed. These may be such items as digitizing, geo-referencing, or sampling for bulk density.

(d) Survey Area Size.

There is no size distinction for order 1 soil survey areas. Order 1 soil survey areas are generally less than 300 acres, but no upper limit is set for general standards. Surveys can be as small as 1 or 2 acres for the purpose of subdivision or site plan review. They can be several thousand acres in size where the application of bio-solids on land is assessed.

(e) Map Scale.

The intended users of the soil survey establish the order 1 map scale. The work plan identifies this scale. The map scale must conform to the delineation of the smallest management unit. If the smallest management unit is 0.25 acre (104 feet by 104 feet), then the map scale should be such that an area this size can be delineated. Generally, the map scale is larger than 1:12,000, and frequently it is 1:1,200 or larger.

(f) Map Unit Kind.

Most map units in an order 1 soil survey use a single component to represent a homogeneous unit. A taxonomic class name at the soil family or soil series level commonly identifies the component, however alternative naming is allowable. In some areas, complexes of two or more soils occur even at the intensity of an order 1 survey. Where a map unit is a soil complex or an undifferentiated group, indicate the relationship of the soil components as clearly as possible. If the components correspond with surface features, describe the observable feature. If the components correspond with subsurface features, such as an undulating bedrock surface, state the relationship.

(g) Placement of Soil Lines.

Map units are designed to group areas of similar behavior for the use of the survey. Line placement therefore depends on the concerns that are being addressed. Setting accuracy standards for line placement is not possible. Generally, line placement is as accurate as practical and within tolerable limits of human observation and error.

Grid mapping with intervals of 10 to 200 feet (3 to 60 meters) helps to place boundaries between map units with similar surface and landscape characteristics. Detailed contour maps and shaded relief maps, such as digital elevation maps and digital orthophotography, improve the precision of line placement at physiographic boundaries. Line placement on sloping sites may require a contour map with a 1- to 2-foot interval. If detailed contour maps are not available, place special emphasis on measuring slope gradient, slope shape, and slope length.

(h) Soil Survey Documentation.

Transects on predetermined sites assist in the identification of the purity of the soil map unit delineation. They also can be used for designing map units. Unbiased sampling of soil properties near the surface and in the subsoil is important for an order 1 soil survey. Many types of properties near the surface can be examined. A partial list includes: surface horizon color (moist and dry for reflectance), albedo, surface horizon thickness, content of clay in the surface horizon, content of rock fragments at the surface, and bulk density in the upper 50 centimeters of the surface layer.

To aid the transfer of data from the order 1 soil surveys to other areas, order 1 soil surveys include detailed soil pedon descriptions for all map unit components.

Documentation, especially on the larger map unit polygons, quantifies map unit composition and the variability of surface features. Examples are site notes, pedon descriptions, and transects. All map units include descriptions of slope, position on the landscape, and land use.

The amount and kind of documentation depend upon the purpose and application of the survey.

(i) Georeferenced Point Data.
All point data for transects and grid sampling are georeferenced. These data become spatial layers.

(j) Order 1 Soil Survey Results.
Order 1 soil survey, as a minimum, include a soil map, a legend of map symbols and map unit names, and narrative descriptions of the soils. The maps include the geographic location and size of the site, soil map unit delineations, the date the soil map was produced, the surveyor's initials, and the map scale. Optional information includes the nature of the soil/landscape relationships, distinguishing landscape features, soil profile descriptions, transect data, field notes, supporting laboratory information and interpretations. The work plan guides the format and subject matter of the resulting report.

(k) Correlation.
Correlation of an order 1 soil survey with adjacent soil surveys is optional. Within an order 1 soil survey area, correlation involves the consistent assignment of map units to delineations. The order 1 soil survey enhances previously existing soil information.

(l) Product Delivery.
It is recommended that all products be electronic if possible. Tools for electronic delivery include both geographic information systems and computer-assisted drafting software. Electronic files for an order 1 soil survey can be posted on an ftp server and shared with researchers. The digital soil coverage requires a populated attribute database. Digitizing allows for quick delivery of products.

(m) Official Status.
An order 1 soil survey is a supplement to the "*official*" soil survey and not a replacement. Data and maps from the order 1 soil survey may be published in conjunction with research.

655.05 Marketing

Marketing is a process of organized thought and action that helps achieve product or organizational goals. Marketing is not the same as selling, promotion, and advertising. Marketing includes these activities but additionally takes into account the desires of the intended audience.

Marketing can be passive or active. Every interaction with a client as part of regular activity of the organization is part of passive marketing. The way you answer the phone, the timeliness of your assistance, the quality of your help, the professionalism of your staff, and the appearance of your products and office all send a message. This is passive marketing. People form opinions of your organization based on these types of factors. Logos and slogans when used consistently create a visual or verbal identity for the organization. These are reminders of the image created through other methods. The goal of an organization is to create an image that appeals to the interests and desires of certain key audiences.

Active marketing is a very focused effort that ensures customer involvement in the development of products that support the purpose of the sponsoring group. A marketing plan helps organize specific marketing activities. A marketing plan normally includes 8 steps.

i. State the problem and goal
ii. Identify target groups
iii. Research the target clients and the conditions.
iv. Identify specific objectives
v. Develop your market position
vi. Develop strategic and tactical plans.
vii. Implement the action plan
viii. Evaluate the plan

1. State the problem and goal. State clearly and concisely the problem, the opportunity, or the need this plan will address. Do not list specific objectives.

2. Identify target groups. Identify target client groups that can help accomplish your purpose. Who can help attain your goal that is identified in the first step? Take each group and subdivide it into smaller groups that have common identifiable characteristics. Who can make a change? Then, put these target markets in a priority order for addressing in this plan. If possible identify the people who influence the market. These individuals may be valuable in your strategy for reaching the target group.

   Identify the actions that you want the customer to carry out in order to benefit your goal. Perhaps you want them to utilize soils information to prevent resource damage to a watershed.

3. Research the target clients and the conditions. Research the target groups and the environment and relationships. Learn about the economics, construction trends, demographics, age, race and other information about the target client groups and the areas or people they serve.

   Contact the client groups and visit about their needs. These customers often share your goals but have specific product needs in order to carry out their actions. Listen closely to their needs. What specific products can be tailored to these clients? Each step should ensure that the product meets the needs of customers. Learn as much as you can about competitors. These may be other people with vested interest or consultants providing other information.

4. Identify specific objectives. Develop a set of specific objectives with the customer. Be very specific. In all cases the intended target groups must be involved. One way to write your specific objective would be to complete the statement, "This program is a success if ..." It is important to be realistic in your objectives. Make sure they are achievable.

5. Develop your market position. Assess your capabilities to produce and deliver the requested product. What advantage does your agency have? Who else can provide the needed information? This assessment helps to determine the outside resources that are needed.

6. Develop strategic and tactical plans. Incorporate the above items into an action plan. Determine your messages and the media to deliver them. Break down the plan into various activities. Each activity is clearly stated as an action item. Assign the person responsible and agree upon a completion date. Tie the plan together with mileposts for completion of various parts. Interrelate various actions that are prerequisite to other actions. Fully address implementation and training that may be needed.

7. Implement the action plan. Assign resources to carry out the work elements and take action.

8. Evaluate the plan. Almost all plans need modification because of unforeseen events. Stay flexible and in contact with the client groups. Build the review and evaluation into the marketing plan so those customers continue to be involved. Modify the marketing plan as conditions change or delays occur.

Exhibit 655-1 Example of a Marketing Plan

The mission of the Soil Survey Division is to: *Provide leadership and service to produce and deliver scientifically-based soil information to help society to understand, value, and wisely manage global resources.*

Marketing Plan for Collapsible Soils Concern

1) Problem and goal.

Construction of houses and roads on collapsible soils has led to loss of property and to personal injury. Roads, houses, and pipelines have been damaged from the collapse of soils. If soil information were understood and used these areas of collapsible soils could be identified and avoided or the structures could be designed to withstand or reduce the risks of collapse. The goal is to reduce the loss of property damage from collapse of these soils.

2) Target client groups.

State and county highway construction engineers and planners and city roads departments handle road construction. Home builders and land developers design and locate homes on various soils. Land use planners at the county provide zoning that approves construction plans. Landscapers work with homeowners and businesses to design and locate vegetation and surface drainage that can accelerate or reduce collapse. Conservation districts review subdivision plans.

The targeted clients in priority are:

1. County land use planners in county w, x, y, and z where soil conditions occur.
2. Conservation district officials and NRCS field offices in targeted counties.
3. State highway department.
4. City road departments in affected cities.
5. Developers and homebuilders in problem areas.
6. Landscaping companies in affected areas.

3) Research

The land use planners and zoning boards are primarily made up of realtors and developers. In visiting with some of the key individuals a map of these areas is the first requirement. Secondly they would like a list of construction practices that can reduce the risk of collapse prior to construction and for areas already built.

They are well aware of problem areas already encountered but not the location of other problem areas.

The conservation districts and local district conservationists have excellent rapport with city and county officials.

The three counties have rapid growth from retirees. The industrial tax base is low. Urban services are stressed financially. Low cost affordable housing is the dominant building practice. Slab foundations are typical.

The counties have good geographic information systems but lack soil information.

4) Specific Objectives.

a. Reduce the number of new homes damaged by collapse by 50% by having developers bypass severe problem areas and by having them adopt effective land preparation techniques to overcome the problem.

b. Reduce the loss of pipelines and streets by 50% by identifying problem areas and sharing construction techniques with officials.

c. Reduce the number of currently constructed houses from collapsing by sharing information with landscapers and homeowners concerning proper roof gutters and landscaping.

5) Market Position.

The NRCS is the sole source of soil information. The soil survey identifies soils subject to collapse from hydro-compaction and from gypsum dissolution. The STATSGO map and database provides coverage of the state but the soil factors needed for identifying areas subject to collapse are not within the database. The NASIS database includes these data elements. GIS capabilities are lacking because the surveys are not digitized.

6) Strategic and Tactical Plan.

ACTION	WHO	WHEN
a. Assemble material concerning collapsible soils	SSS	8/99
b. Select priority counties based on problem areas and land use patterns	SSS	9/99
c. Assemble material on demographics, target groups	DC	12/99
d. Visit client groups	DC/SSS/RS	2/00
e. Develop county maps from SSURGO	SSS	4/00
f. Submit draft maps to clients	SSS	6/00
g. Work with landscapers and contractors to assemble methods to overcome limitations	RSS	1/99
h. Take pictures of failures, assemble news stories	RSS/DCs	5/00
i. Delivery all materials at a presentation to each group	DC/SSS	7/00
j. Arrange for follow-up assistance and news releases	PAS/SSS	9/00

7) Implementation

Commit resources and funds to project.

8) Evaluation

Two counties had active GIS systems and preferred to develop the maps themselves. So instead of making maps for them the data was provided plus the interpretation for collapsible soils. The county planners and county officials also took over leadership in working with landscapers and contractors through local workshops and information handouts at the time zoning changes were requested and building permits were let.

County extension put out information about landscaping and roof gutters to minimize excess water around foundations.

County z did not have GIS capability and welcomed a map which they provided to builders and county planner.

Collapsing structures are minimal since construction began this spring but a dry season makes the success hard to evaluate. Additional follow-up and workshops need to continue.

Amendment 1 (September 1997)

General changes:

- Soils Division to ***Soil Survey Division***
- National Cartography and GIS Center to ***National Cartography and Geospatial Center***
- Electronic Imaging and Design staff at National Headquarters to ***National Production Service Staff at the National Business Management Center at Fort Worth, Texas***

Specific changes:

1. Table of Contents - General

- Add the statement: ***Unlisted parts are reserved***

2. Table of Contents - Detailed

- Part 601.01 (e) - Change GIS to ***Geospatial***
- Detailed part 607 - Strike out <u>607.02</u> and renumber 607.03 to ***607.02***

3. Subject Index - Conventional and Special Symbols Legend

- Add ***and definitions*** after legend

4. Part 607

- Contents - Strike out <u>607.02 General</u>
- Renumber 607.03 to be ***607.02***
- On first page - Renumber 607.03 to be ***607.02***
- Exhibit 607-2 - Add the following statement to the end of the listing: ***The sources indicated herein are in no way endorsed by the Government as being the preferred vendor of choice. Proposed acquisitions by the Government shall be in accordance with the applicable Federal Acquisition Regulations and in full compliance with the Competition and Contracting Act and Procurement Integrity Act.***

5. Part 609

- 609.05 (a)
    - ◊ (2) Replace the current statement with: ***The MLRA office assures the quality of detailed soil survey maps prepared for public distribution including assuring that joins are achieved. Joining is addressed from the initiation of a soil survey and achieved through progressive correlation. Joining between previously correlated soil survey areas is addressed prior to the compilation/recompilation step of the digitizing process with an addendum to the correlation.***

◊ (3) Replace the fifth statement with: --*the exact or acceptable join of map unit lines and concepts across map sheets within the survey area and across survey area boundaries, and*

◊ (6) Replace the current statement with the following paragraphs: *It is the intent of soil survey to provide seamless joins across political boundaries. Where an exact join cannot be accomplished, all discrepancies are to be documented, recorded, and filed in the final correlation. These joining statements are recommended to the MLRA office by the project office or other office discovering the discrepancies. Joining statements and types of joins refer to the boundary of two surveys. When completing a survey, the boundary with each of the other survey areas is to be joined and documented.*

Two types of joins are recognized; an exact join and an acceptable join.
(i) An exact join occurs when two soil survey areas join lines and features exactly along common boundaries and the joined soil polygons share the same NASIS data mapunit.
(ii) An acceptable join occurs when an exact join is not made but the join is acceptable to the MLRA office and the state soil scientist until an exact join can be made. An acceptable join occurs when the lines match as close as possible and adjoined map units have similar soil properties and interpretations.

◊ (7) Replace the paragraph with: *The following examples describe the most common join situations and provide general guidelines for obtaining an exact or acceptable join between survey areas. A reasonable attempt to join previously correlated surveys should be made before digitizing. An acceptable join is to be made between surveys with current status when an exact join is not immediately possible.*

◊ (i) Replace the paragraph with: *If two ongoing surveys of the same order of mapping are being joined, an exact join is required. Exact joins are required between two adjacent survey areas if both of the areas were correlated after January 1993.*

◊ (ii) Replace the first two sentences with: *If an ongoing survey is being joined with a modern correlated survey and both surveys are of the same order, an acceptable join is required. The lines should be joined exactly between surveys, and soil taxa and interpretations are to be the same or similar. Where obvious errors in the previously correlated survey are documented and preclude the practical resolution of the join in a timely manner, the mis-join is documented in the correlation of the ongoing survey and with the official copy of the previously correlated survey for future resolution at an update. In some instances, the join may require the addition of small acreage map units to the ongoing soil survey or corrections on the maps of the recently correlated soil survey.*

◊ (iii) Replace with: *If two soil surveys of different orders of mapping are being joined, an acceptable join is in effect since the boundary between soil survey areas also serves as soil area boundaries. A note is printed parallel to the boundaries that separate the areas of each survey order, such as "Limit of Order 3 Survey". Chapter 2 of the Soil Survey Manual provides more information. Each soil line in the survey of lower intensity must have a corresponding soil line in the adjacent survey of higher intensity, but the converse is not required. Named taxa of a map unit from the survey of lower intensity share a* *common taxonomic class, at some categorical level, with a named taxon from at least one of the map units in the adjacent survey of higher intensity.*

- ◊ (iv) Replace with: ***If an ongoing soil survey borders a survey area that requires extensive revision and is out-of-date and therefore acknowledged as being obsolete, it is not necessary to attain an exact or acceptable join or revise any part of the out-of-date survey until such time as a maintenance project is initiated. The joining statement in the correlation should state the situation.***

- ◊ Add the following: ***(v) When two previously correlated surveys are prepared for SSURGO, an acceptable join is adequate. In this instance there is usually no Project Office staff available to investigate join discrepancies in the field. Adjust lines and associated data as is practical from the office to affect the best possible acceptable join. This generally involves moving lines slightly to conform with new imagery and to come together at the same point along the survey boundary, and coordinating the boundary between the two surveys. At the discretion of the state soil scientist and MLRA office, it may also involve recorrelation of soils in one or both of the survey areas. Digital soil surveys and join documentation and statements in the correlation and its addendums are tools for future update activities to implement MLRA legends and exact joins. The MLRA office initiates a plan for completing an exact join between soil surveys that have been joined for expediency with an acceptable join.***

- Part 609.06 (c) (5)

  - ◊ Last paragraph now reads: ***Amendments to the final correlation document are given the same signatures and distribution as the original document.***

- Exhibit 609-1

  - ◊ Add EEO statement to the heading: ***The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (Voice and TDD). To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C., 20250, or call 1-800-245-6340 (voice) or (202) 720-1127 (TDD). USDA is an equal employment opportunity employer.***

6. Part 610

- Part 610.01 (d) - Add the following statement: ***--preparing and signing amendments to the correlation***
- Part 610.07 - Add the following statement after the second sentence: ***The MLRA office and State Conservationist sign the amendment. Distribution is the same as the final correlation. Refer to part 609.06 (c) (5).***

7. **Part 617**

- Part 617.04 and 617.05 - Change reference to part 617.11 to ***part 617.10***
- Part 617.10 Step 6 (b) - Add at the end of the paragraph: ***The new interpretation generator recognizes the progressive effect of a property on the interpretation. The curve for approximate reasoning (fuzzy logic) reflects the increasing, decreasing, or constant effect that varying degrees of a property have on the interpretation. This is implemented in the evaluation phase of the interpretation generator.***

8. **Part 618**

- Part 618.01 (c) - Add to the end of the paragraph the following statement: ***This includes all data elements listed in part 618.***

- Part 618.10 Climatic Setting

  ◊ First paragraph, first sentence - Add ***evapotranspiration***

  ◊ First paragraph, second sentence - Replace frost-free period, precipitation, and temperature with: ***These elements***

  ◊ Add (d) and (e) below:

  (d) Daily Average Precipitation

  (1) Definition. Daily average precipitation is the total precipitation for the month divided by the number of days in the month for the standard "normal" period, 1961-1990.
  (2) Entries. Enter the high, low, and representative value in mm. The range of allowed entries is 0 to 750 mm.

  (e) Daily Average Potential Evapotranspiration

  (1) Definition. Daily average potential evapotranspiration is the total monthly potential evapotranspiration divided by the number of days in the month for the standard "normal" period, 1961-1990.
  (2) Entries. Enter the high, low, and representative value in mm. The range of allowed entries is 0 to 300 mm.

- Part 618.43 (d)

  ◊ Remove <u>and pararock</u> from first sentence of this part

  ◊ At the end of last paragraph, add the following statement: ***Pararock fragments are not cemented strongly enough to be retained on sieves. They are crushed and estimated into percent passing sieves. ASTM procedures use a roller crusher as a pretreatment of the soil material prior to sieving. Field estimates should try to replicate this procedure.***

- Part 618.67 (h) (2)

◊ Renumber vii, viii, and ix to ***vi***, ***vii***, and ***viii***

◊ Add (ix) and (x)

(ix) Limnic materials are used as modifiers to texture to describe the origin or the material. These materials were deposited in water by precipitation or through the action of aquatic organisms or derived from plants and organisms. These modifiers are used to indicate presence and origin without respect to any set amount. Refer to the Keys to Soil Taxonomy for complete definitions of limnic materials.
<u>Coprogenous</u> -- Coprogenous-earth or sedimentary peat is limnic layer which contains many very small (0.1 to .001 mm) fecal pellets.
<u>Diatomaceous</u> -- Diatomaceous-earth is a limnic layer composed of diatoms.
<u>Marly</u> -- Marl is a limnic layer that is light colored and reacts with HCl.

(x) <u>Permanently frozen</u> -- Term applied to soil layer in which the temperature is perennially at or below 0 degrees C, whether its consistence is very hard or loose.

- Exhibit 618-15 - Remove <u>SR Stratified</u> (Stratified is handled as a YES or NO entry with NASIS)

9. Part 622

- Part 622.01 Policy and responsibilities: Remove the third paragraph referring to the regional office

- Part 622.03 (d) - Change entries 2 through 70 and add 10 as follows:

2 - Prime farmland if drained.
3 - Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 - Prime farmland if irrigated.
5 - Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
6 - Prime farmland if irrigated and drained.
7 - Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season.
8 - Prime farmland if subsoiled, completely removed the root inhibiting soil layer.
9 - Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60.
10 - Prime farmland if irrigated and reclaimed from excess salts and sodium.
30 - Farmland of statewide importance.
50 - Farmland of local importance.
70 - Farmland of unique importance.

- Part 622.09 (a)
  - ◊ Rename the section to ***Rangeland***
  - ◊ Delete first paragraph (Range is any land ...). Intent: Range is a land use not an ecological group.
  - ◊ Move third paragraph (Rangeland is land on which ...) to the first paragraph
  - ◊ Delete last paragraph (Forested range is forestland that ...). Intent: Forested range is a land use, not an ecological group.
  - ◊ Change the name of Part 622.09 to ***Rangeland*** in the contents at front of part 622 and in the detailed table of contents

10. Part 623

- Part 623.01 (a) - Change "are" to ***and*** in last sentence

11. Part 627

- Part 627.04 (e) (1) (i) - After the third sentence add: Avoid using the lowercase letters "i", "j", "q", and "l" because, when handwritten, these letters are easily confused with other letters or the number 1.

12. Part 630

- Exhibit 630-2 Benchmark Soil List By State - Add the Ohio benchmark soils

OH	***Bennington***	***fine, illitic, mesic Aeric Epiaqualfs***
OH	***Canfield***	***fine-loamy, mixed, mesic Aquic Fragiudalfs***
OH	***Celina***	***fine, mixed, mesic Aquic Hapludalfs***
OH	***Chagrin***	***fine-loamy, mixed, mesic Dystric Fluventic Eutrochrepts***
OH	***Chili***	***fine-loamy, mixed mesic Typic Hapludalfs***
OH	***Cincinnati***	***fine-silty, mixed, mesic Oxyaquic Fragiudalfs***
OH	***Clermont***	***fine-silty, mixed, mesic Typic Glossaqualfs***
OH	***Conneaut***	***fine-silty, mixed, nonacid, mesic Aeric Epiaquepts***
OH	***Glynwood***	***fine, illitic, mesic Aquic Hapludalfs***
OH	***Guernsey***	***fine, mixed, mesic Aquic Hapludalfs***
OH	***Hanover***	***fine-loamy, mixed, mesic Typic Fragiudults***
OH	***Hoytville***	***fine, illitic, mesic Mollic Epiaqualfs***
OH	***Latty***	***fine, illitic, mesic Typic Epiaquepts***
OH	***Loudonville***	***fine-loamy, mixed, mesic Ultic Hapludalfs***
OH	***Mahoning***	***fine, illitic, mesic Aeric Epiaqualfs***
OH	***Mermill***	***fine-loamy, mixed, mesic Mollic Epiaqualfs***
OH	***Miamian***	***fine, mixed, mesic Oxyaquic Hapludalfs***
OH	***Millgrove***	***fine-loamy, mixed, mesic Typic Argiaquolls***
OH	***Olentangy***	***fine-silty, mixed, nonacid, mesic Histic Humaquepts***
OH	***Paulding***	***very-fine, illitic, nonacid, mesic Typic Epiaquepts***
OH	***Platea***	***fine-silty, mixed, mesic Aeric Fragiaqualfs***
OH	***Rossmoyne***	***fine-silty, mixed, mesic Aquic Fragiudalfs***
OH	***Toledo***	***fine, illitic, nonacid, mesic Mollic Endoaquepts***
OH	***Wellston***	***fine-silty, mixed, mesic Ultic Hapludalfs***

OH　　*Wooster*　　*fine-loamy, mixed, mesic Oxyaquic Fragiudalfs*

13. Part 639

- Part 639.02 (b) 2nd paragraph., 2nd sentence: indicated by the ***NASIS site*** and group columns

- Part 639.06 (a) - General Changes
  - ◊ Change database object to ***NASIS site object***
  - ◊ Change database table to ***NASIS site table***
  - ◊ Change National Soil Information System database to ***National Soil Information System site***

- Part 639.06 (a) - Specific Changes
  - ◊ Title line: The ***NASIS site*** object
  - ◊ 1st line: The purpose of the ***NASIS site*** object is
  - ◊ 6th line: site has an entry in the ***NASIS site*** object and
  - ◊ 2nd paragraph: The ***NASIS site*** object includes the NASIS site, group, user, and
  - ◊ 3rd paragraph: The ***NASIS site*** table ***lists all NASIS sites and users***. This table enables the National Soil Information System to share data from site to site. ***NASIS site*** records accompany requested data. The fields in this table identify the ***NASIS site*** and who to contact if you have any questions about that data.
  - ◊ 5th paragraph: Descriptions for data elements in the ***NASIS site*** object are available in National Soil Information System on-line documentation.
  - ◊ 8th paragraph: Authority to edit a ***NASIS site*** object is limited to a user who has NASIS manager privileges for that object.

- 639.06 (a) (1)

  - ◊ (1) ***NASIS site*** table: database iid (on screen label: Rec ID).

    (i) Definition. Database iid is the identification number of the ***NASIS site*** that created a particular entity. This is a required integer field that uniquely identifies the local ***NASIS site***. This number must be obtained from the soil hotline staff BEFORE the National Soil Information System ***site*** is installed.

  - ◊ (2) ***NASIS site*** table: database name (on screen label:***NASIS site name***).

    (i) Definition. Database name is the name of a particular National Soil Information System ***site***. The database name has a required 30 character field that records the name that identifies the local ***site***. This name must be obtained from the soil hotline staff BEFORE the National Soil Information System ***site*** is installed. This is the source of the ***NASIS site*** name that is displayed in the National Soil Information System edit windows.

◊ (3) ***NASIS site*** table: database description (on screen label: Description).

(i) Definition. Database description is a narrative text entry that contains information about a particular National Soil Information System ***site***. The database description has an optional 60 character field that describes the ***site*** to other locations.

◊ (4) ***NASIS site*** table: database state (on screen label: State).

(i) Definition. Database state is the name of the state in which a particular National Soil Information System ***site*** resides. It is expressed as the Federal Information Processing Standards (FIPS) alpha state code.

◊ (5) ***NASIS site*** table: database county (on screen label: County).

(i) Definition. Database county is the name of the county or other division in which a particular National Soil Information System ***site*** resides.

◊ (6) ***NASIS site*** table: database city (on screen label: City).

(i) Definition. Database city is the name of the city or other location in which a particular National Soil Information System ***site*** resides.

◊ (7) ***NASIS site*** table: database office type (on screen label: Off Type).

(i) Definition. Database office type is the name for the type of office in which a particular National Soil Information System ***site*** resides.
(ii) Classes. Add: ***other Other type of office***

◊ (8) ***NASIS site table***: database contact (on screen label: Contact).

(i) Definition. Database contact is the name of the primary contact person for a particular National Soil Information System ***site***.

◊ (9) ***NASIS site*** table: database phone (on screen label: Phone).

◊ (10) Group table: group name (on screen label: Group).

(i) Definition. Group name is the name of a particular National Soil Information System group in a particular National Soil Information System ***site***.

◊ (14) User table: user name (on screen label: User).

(i) Definition. User name is the name of a particular National Soil Information System user in a particular National Soil Information System ***site***.

- 639.06 (b) The query object.

  ◊ 2nd paragraph: The query object comprises the query table. Ownership of a specific query object is indicated by the ***site*** and group columns in the query table. Authority to edit the query object is limited to users who are members of the group that owns the query.

14. Part 647

- Part 647.01 (a) (5); 647.03 (b), (d), and (e); part 647.07 (h) (2); part 647.08 (b); 647.09 (a); and under Postscript Plot files - Change Exhibit 627-4 to ***Exhibit 627-5***

- 647.01 (b) (2) Soil Survey Project Office - Add the following responsibilities:
  ◊ ***achieving an exact or an acceptable join as described in part 609.05 for soil surveys in progress,***
  ◊ ***supervising map compilation (or coordinate with dedicated map compilation units if established) for soil surveys in progress in preparation for digitizing and publication as described in NSSH part 647,***
  ◊ ***quality control of map compilation activities (100% check) for soil survey in progress,***
  ◊ ***quality control of all phases (soil business) of soil survey in progress,***
  ◊ ***assisting in development of field correlation under direction of the MLRA office, and***
  ◊ ***initiating documentation on joins.***

- 647.01 (b) (3) MLRA Office - Replace the section with the following:
  ◊ ***providing technical oversight and quality assurance for all phases of active soil survey projects;***
  ◊ ***assuring that exact or acceptable joins are achieved;***
  ◊ ***performing correlation activities in a manner that will lead to a coordinated soil survey throughout MLRAs and between MLRAs;***
  ◊ ***approving all correlation documents, including amendments to previously correlated surveys, in coordination with the appropriate state conservationist;***
  ◊ ***assuring the quality of all map compilation/recompilation through a 10% check and certification (a locally administered certification process may be established where dedicated compilation units exist);***
  ◊ ***assuring the quality of soil databases;***
  ◊ ***assisting states in the preparation of metadata;***
  ◊ ***informing states of any deficiencies in work submitted for review and assisting states with the resolution of theses problems;***
  ◊ ***coordinating with states as needed for delivery of all map materials, soil data, and metadata to the digitizing unit for processing;, and***
  ◊ ***initiating plans for completing an exact join between soil surveys that have been joined for expediency with an acceptable join.***

- Add the following section: 647.01 (b) (4) State Offices
  The state office is responsible for:
  ◊ ***determining priorities for soil survey areas to be digitized within each state;***
  ◊ ***identifying and working with organizations outside of NRCS that can help us achieve our digitizing goals and coordinating with digitizing units and MLRA offices concerning these activities;***

- ◊ *deploying sufficient staff to achieve agreed upon goals for the digitizing initiative;*
- ◊ *obtaining all map materials needed in the state to perform map compilation/recompilation activities, including those needed for a check of joins with other survey areas;*
- ◊ *coordinating with soil survey project offices in the state concerning the flow of map compilation work for soil surveys in progress;*
- ◊ *supervising recompilation (or coordinating with dedicated map compilation units if established);*
- ◊ *reviewing joins with surrounding surveys and making corrections to achieve an acceptable join for recompilation of existing surveys;*
- ◊ *quality control of map recompilation activities (100% check);*
- ◊ *initiating correlation amendments/supplements through the MLRA office as needed for SSURGO for recompiled soil surveys;*
- ◊ *preparing and providing metadata for all compiled/recompiled surveys from the state which are submitted to digitizing units (through the MLRA office) for digitizing;*
- ◊ *downloading soils data for SSURGO for all compiled/recompiled surveys from the state which are submitted to digitizing units (through the MLRA office) for digitizing; and*
- ◊ *certifying, following quality review and completion of digitizing.*

- Add the following section: 647.01 (b) (5) Digitizing Units
  Digitizing units are responsible for:
  - ◊ *coordinating compilation/recompilation and soil business activities with states and MLRA offices to ensure an orderly flow of work for all soil surveys which are to be digitized through the digitizing unit;*
  - ◊ *performing pre-certification review of submitted materials;*
  - ◊ *notifying MLRA offices of any problems discovered during pre-certification review which require action by the MLRA office or states prior to certification;*
  - ◊ *digitizing compiled map materials including scanning soil lines, labeling, and edge matching;*
  - ◊ *performing quality control of final digital data including spatial, tabular, and metadata;*
  - ◊ *coordinating with the MLRA office to obtain a SSURGO certification letter from the state conservationist of the state whose survey is digitized; and*
  - ◊ *submitting certified SSURGO data to National Cartography and Geospatial Center for 10% quality review, and for archiving and distribution.*

- Change NCG responsibilities to ***647.01 (b) (6) National Cartography and Geospatial Center*** and replace with the following:
  The National Cartography and Geospatial Center is responsible for:
  - ◊ *providing training in SSURGO quality assurance activities;*
  - ◊ *providing technical assistance to states, MLRA offices, and digitizing units in spatial, tabular and metadata development to meet SSURGO specifications;*
  - ◊ *communicating changes/updates and enhancements to SSURGO certification routines and procedures;*
  - ◊ *performing 10% review of SSURGO materials received from digitizing units;*
  - ◊ *archiving and distributing certified SSURGO data;*
  - ◊ *developing and updating map compilation, digitizing, and map finishing procedures; and*
  - ◊ *coordinating and implementing software updates to reflect changes in standards.*

- Add the following section: ***647.01 (b) (7) Regional Offices***
  The regional offices are responsible for:
  - ◊ ***allocating funds to states, MLRAs, and digitizing units to be used for soil survey digitizing and SSURGO development;***
  - ◊ ***incorporating soil survey digitizing and SSURGO development performance measures in strategic plan; and***
  - ◊ ***providing oversight and evaluation to ensure that desired outcomes are met.***

- Change the NSSC responsibilities to ***647.01 (b) (8)*** and replace the responsibilities with the following:
  - ◊ ***developing standards, guidelines, and procedures for all aspects of soil survey work, soil map development, and SSURGO certification;***
  - ◊ ***developing and applying geographic information systems for use with soil survey activities; and***
  - ◊ ***developing, maintaining, and improving soil survey geographic databases.***

- Add the following section: ***647.01 (b) (9) National Headquarters***
  The Soil Survey Division and National Soil Information Coordinator are responsible for:
  - ◊ ***reviewing and monitoring the SSURGO development process;***
  - ◊ ***issuing policy; and***
  - ◊ ***coordinating with states, MLRA offices, regional offices, National Cartography And Geospatial Center, and National Soil Survey Center on soil survey compilation, digitizing, and map finishing issues.***

- 647.03 (e) (3) - Replace (i) with the following:
  - ◊ ***(i) Soil area boundaries. All soil, miscellaneous, and water areas that occupy area are delineated as map units. Their boundaries will be accurately transferred from field sheets to the compilation documents. All feature edges will be matched and extended across the neatline of all adjoining sheets to ensure accuracy in the joining. Any discrepancies between matches should be resolved and approved by the MLRA office.***

- Part 647.03 in the paragraph preceding (g) - Add ***(f)*** to Ad hoc features

- Part 647.05
  - ◊ Add ***(a) Planimetric correct base*** as headline to the first paragraph
  - ◊ Add ***(b) Line adjustment*** as headline to the second paragraph
  - ◊ Add ***(c) Documenting changes in line placement*** as headline to the third paragraph
  - ◊ Change wording in the third paragraph to be***: Document changes in line placement and, if needed, provide a supplement*** ...
  - ◊ Change (1) Minimal Requirements to ***(d) Minimal Requirements***
  - ◊ Change (I) Memorandum of Understanding to ***(1) Memorandum of Understanding***
  - ◊ Change (ii) Supplement To A Published Soil Survey Map ***to (2) Supplement to a published soil survey map***
  - ◊ Change (iii) Classification and Correlation Document to ***(3) Classification and correlation document***

- Exhibit 647-1 - Suggested Compilation Edit Checklist

- ◊ Replace the statement in the Soils Section that states:
  "___ A quality join exists with adjoining soil survey areas."
  with
  ___ ***An exact or acceptable (choose one) join exists with adjoining***
  ___________________***soil survey area. (repeat for each adjoining survey area.)***

- Exhibit 647-3 Map Compilation Certification
  - ◊ Replace statement 3 with: ***3. Map unit delineations and their symbols match across map boundaries and an exact or acceptable (choose one for each adjacent survey) join has been achieved with adjacent surveys.***

- Exhibit 647-4 Supplement To A Published Soil Survey Map
  - ◊ In the last sentence of the first paragraph change the word improved to ***enhanced***

- Exhibit 647-11 SSURGO Metadata Template
  - ◊ Under Data Quality Information remove the phrase <u>and are current as of the date of digitizing</u> from the end of the first paragraph

- Exhibit 647-12 Checklist for SSURGO Data
  - ◊ Replace the statement below under the Accuracy title:
    Soil delineations and map unit composition match across soil survey area boundaries.
    with:
    Soil delineations and map unit composition have an exact or acceptable (choose one) join across soil survey area boundaries.

15. Part 648

- 648.03 (a) (1) - Change Part 647.10 to ***Part 647.07***
- 648.04 (d) - Change the 2nd paragraph (d) to ***(e)*** and the following to (e) to ***(f)***

16. Part 649

- Exhibit 649-1
  - ◊ Remove <u>106</u> from MO10 and add ***106*** to MO 5
  - ◊ Remove <u>30</u> from MO 8 and add ***30*** to MO 2
  - ◊ Add ***31*** to MO 2 list (MLRA 31 is shared between MO 2 and MO 8)

Amendment 2 (November 1997)

Specific changes:

1. **Part 601**

   - 601.01 (d) - Add the following to the first line: ***including the maintenance and updating of soil surveys;***

2. **Part 602**

   - Exhibit 602-1, Article III, Section 1.0 - Change to: ***Director of Soil Survey***

   - Exhibit 602-1, Appendix A
     - ◊ Change Agricultural Stabilization and Conservation Service to ***Farm Services Agency***
     - ◊ Change National Bureau of Standards, U.S. Department of Commerce to ***National Institute of Standards and Technology, U.S. Department of Commerce***
     - ◊ Add ***Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture***
     - ◊ Add ***National Agricultural Statistics Service, U.S. Department of Agriculture***
     - ◊ Delete <u>Federal Crop Insurance, U.S. Department of Agriculture</u>
     - ◊ Delete <u>Science and Education Administration, U.S. Department of Agriculture, Extension, CRIS</u>
     - ◊ Delete <u>State Agricultural Experiment Stations</u>

3. **Part 606**

   - 606.01 (a) - Add the following as a paragraph under the bulleted items: ***Total acreage for all surveys within the state should total the Natural Resource Inventory acreage for the state. This acreage is matched to the scheduler and the map unit records.***

4. **Part 607**

   - Exhibit 607-2 - Add under color charts:

     Color Communications, Inc.
     229D Manchester Road
     Poughkeepsie, NY 12603
     1-800-575-6064

5. **Part 608**

   - 608.08 (a) - Under Scheduler attributes, add the following: ***The total acres of the soil survey area is the same as used in the Natural Resource Inventory (NRI). The total acres of all surveys within a state is the same as used in the Natural Resource Inventory (NRI) state total.***

- 608.10 (b) - Replace the current paragraph with the following: ***The operational status categories are displayed on the Status of Soil Surveys map in the following colors: Published (F), dark green; Project (P1), yellow, indicating that the field mapping is in progress or Project (P2), light green, indicating that the field mapping is complete; Nonproject (N), white; Out-of-Date (D), red; Update (U1), blue, indicating that the field mapping is in progress; and Update (U2), orange, indicating that the field mapping is complete.***

6. **Part 610**

- 610.06 (b) (3) - Change the general manual reference from 402.4 (c) to ***402.5 (e)***

7. **Part 617**

- 617.06 - Replace the last two paragraphs with the following:

  The Memorandum of Understanding is to state which interpretations are to be made for a soil survey area. The MLRA office, state soil scientist, and cooperators should agree on whether interpretations are generated for miscellaneous land types and minor soil components. Entry of data and preparation of soil interpretations for miscellaneous areas are encouraged. Omission of data elements is by joint consensus of the MLRA office, state soil scientist, and cooperators.

  Data elements used as criteria in an interpretation must be completely populated in order to generate reliable interpretations.

  Data elements are to be completely populated for major soil components including map unit components classified as higher taxonomic categories. The MLRA office, state soil scientist, and cooperators should reach a joint decision for special situations where it is not practical to populate data elements for map unit components classified at a higher taxonomic category than soil series. If the range of properties is too wide for interpretations, these areas may not meet the requirements of the user defined needs of the survey.

8. **Part 618**

- 618.48 (c), 2nd paragraph - Replace 2nd, 3rd, and 4th sentences with the following: ***In general, soils that are either highly alkaline or highly acid are likely to be corrosive to steel. Soils that have pH < 5.5 are likely to be corrosive to concrete. Soils that have pH > 8.5 are likely to be highly dispersible, and piping may be a problem.***

9. **Part 627**

- 627.07 - Add "can be" to the first sentence: Phases ***can be*** used to create groupings ...
- 627.07 (a) (4) (ii) - Add "commonly": Surface phases are ***commonly*** used if stones, boulders, ...
- 627.09 - Change the first sentence to the following: Each map unit is given a name that accurately ***and uniquely*** identifies the unit ***within the legend used***.

10. Part 631

- 631.07 (a)
  - ◊ First sentence - Change "over 20,000" to ***more than 23,000***
  - ◊ Second sentence - Change "over 800" to ***more than 600***
  - ◊ Add to the end of the paragraph - ***the internet, or CD-ROM***

11. Part 647

- 647.07 (m) (3) - Replace the first paragraph with the following: ***Statistics are generated for each quadrangle in the soil survey area and for the survey area. The acreage statistics are generated by UTM projection. In addition to quality control, acreage statistics replace the grid dot counts or planimetered acreage normally performed. These statistics are not submitted as a part of SSURGO. Discrepancies of more than 10 percent of the total between the Natural Resource Inventory (NRI) total and spatially determined totals are noted in the SSURGO review. The state soil scientist and MLRA Office leader review and decide where adjustments are needed.***

- Exhibit 647-11

  - ◊ Identification Information Section, under Description, first paragraph - change the first two sentences to the following: ***This data set is a digital soil survey and generally is the most detailed level of soil geographic data developed by the National Cooperative Soil Survey. The information was prepared by ...***

  - ◊ Identification Information Section, under Description, second paragraph - change the third sentence to the following: ***A special soil features layer (point and line features) is optional.***

  - ◊ Identification Information Section, under Description, third paragraph - Replace the paragraph with the following: ***<u>Purpose</u>: SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.***

  - ◊ Identification Information Section, under Cross Reference - Replace the last paragraph with the following: ***Purpose: This soil survey depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.***

  - ◊ Data Quality Information Section, under Attribute Accuracy - At the end of the second paragraph, add the following:

    Edge Match Statements: Edge matching of digital data is described in terms of accuracy of matching of feature edges, feature labels, and descriptive attributes between quadrangles or data sets. In SSURGO, all three are required to match between adjacent quadrangles within the survey. Only the soil survey boundaries are required to match between surveys. Examples of edge match statements for adjacent soil surveys:

The quadrangles in this soil survey are not edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in the Alpha Soil Survey, but are not edge matched to those in the Beta or Gamma Soil Surveys.

Feature edges and descriptive attributes of quadrangles in this soil survey are matched to those in adjacent soil surveys. Feature labels do not match.

◊ Data Quality Information Section, under Attribute Accuracy, following the paragraph on Completeness Reporting - Replace the three paragraphs with the following:

Soil scientists identify small areas of soils or miscellaneous (nonsoil) areas that have properties and behavior significantly different than the named soils in the surrounding map unit. These minor components may be indicated as special features. If they have a minimal effect on use and management, or could not be precisely located, they may not be indicated on the map.

Specific National Cooperative Soil Survey standards and procedures were used in the classification of soils, design and name of map units, and location of special soil features. These standards are outlined in Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS; Agricultural Handbook 436, Soil Taxonomy, Soil Survey Staff, 1975, USDA, SCS; and all Amendments; Keys to Soil Taxonomy, Soil Survey Staff, (current issue); National Soil Survey Handbook, title 430-VI, 1996.

The actual composition and interpretive purity of the map unit delineations were based on data collected by scientists during the course of preparing the soil maps. Adherence to National Cooperative Soil Survey standards and procedures is based on peer review, quality control, and quality assurance. Quality control is outlined in the memorandum of understanding for the soil survey area and in documents that reside with the Natural Resources Conservation Service state soil scientist. Four kinds of map units are used in soil surveys: consociations, complexes, associations, and undifferentiated groups.

◊ Under Explanation of Template Metadata Numbered Elements Section - Change the zip code in item 15 to *50309-2180*

◊ Under Explanation of Template Metadata Numbered Elements Section - Add the following as 20a:

20a - Edge Match Statements: Edge matching of digital data is described in terms of accuracy of matching of feature edges, feature labels, and descriptive attributes between quadrangles or data sets. In SSURGO, all three are required to match between adjacent quadrangles within the survey. Only the soil survey boundaries are required to match between surveys. Examples of edge match statements for adjacent soil surveys:

The quadrangles in this soil survey are not edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in adjacent soil surveys.

The quadrangles in this soil survey are edge matched to quadrangles in the Alpha Soil Survey, but are not edge matched to those in the Beta or Gamma Soil Surveys.

Feature edges and descriptive attributes of quadrangles in this soil survey are matched to those in adjacent soil surveys. Feature labels do not match.

Amendment 3 (April 1998)

Specific changes:

1. **Front Page**

- Change the EEO statement to the following:

  The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

  To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice or TDD).

  USDA is an equal opportunity provider and employer.

2. **Exhibit 647-11**

- Identification Information section, under Description, 2nd paragraph: change optional to ***required***

- Data Quality Information section:
  - ◊ At the end of the 2nd paragraph, add: ______*(20a)*______
  - ◊ Delete the Edge Match Statements section (5 paragraphs)

- Distribution Information section, under Distribution Liability, replace the 2nd paragraph with the following:

  The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

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Amendment 4 (September 1998)

The following changes have been made to the National Soil Survey Handbook in the web version for downloading and in the on-line hypertexted version. The NRCS-SOI-37A will be reprinted and distributed separately.

Specific changes:

1. **Exhibit 602-1**

- Change in all parts: Director of Soils to ***Director of Soil Survey Division***

- Article III - Add the following:
  - ◊ ***Section 2.1.4*** ***Soil scientists from each of the six NRCS regional offices are included as members.***

- Article VI - Change:
  - ◊ ***Section 1.1.4*** ***Four Agriculture Experiment Station Soil Survey Leaders, one from each respective Regional Conference. This normally is the state representative that will be chair or vice chair of the next Regional Conference.***

- Article VI - Add:
  - ◊ ***Section 1.1.7*** ***A representative of the 1890 College from the vicinity of the next conference recommended by the Conference Chair.***
  - ◊ ***Section 1.1.8*** ***A representative of the Tribal College from the vicinity of the next conference recommended by the Conference Chair.***

- Article VI - Change Section 4.0 to be:
  - ◊ ***Section 4.0*** ***The Steering Committee shall:***

- Article VI - Delete:
  - ◊ ***Section 4.1***

2. **Exhibit 606-1 and Exhibit 606-2**

- Last paragraph before signatures, replace with the following paragraph:

  Activities conducted under this Memorandum of Understanding will be in compliance with the nondiscrimination provisions as contained in Titles VI and VII of the Civil Rights Act of 1964, as amended, the Civil Rights Restoration Act of 1987 (Public Law 100-259) and other nondiscrimination statutes, namely Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and in accordance with regulations of the Secretary of Agriculture (7CFR-15, Subparts A and B) which provide that no person in the United States shall on the grounds of race, color, national origin, age, sex, religion, marital status, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving federal financial assistance from the Department of Agriculture or any agency thereof.

3. **Part 618.07**

- Change the formula in 618.07 (c) to:
  $Db_{15} = [(LEP/100) + 1]^3 X Db_{moist}$
  where Db_{15} ***= bulk density 15 bar,***
  LEP = linear extensibility percent adjusted to a <2 mm basis.

4. **Exhibit 618-7**

- Change the 2nd formula in footnote 3 to:
  $PI = LL - [9 + 0.4(clay)]$

5. **Part 618.18 Electrical Conductivity.**
   (b) Classes.

- Change class limits to:

Nonsaline	***0 - < 2***
Very slightly saline	***2 - < 4***
Slightly saline	***4 - < 8***
Moderately saline	***8 - < 16***
Strongly saline	$\geq$ ***16***

6. **Part 618.20**

- Change 618.20 (a) (1) reference to ***M-145-91 (1995)***

- Add to the end of 618.20 (b) (2) the following:

  Under average conditions of good drainage and thorough compaction, the supporting value of a material as subgrade may be assumed as an inverse ratio to its group index, that is, a group index of 0 indicates a "good" subgrade material and group index of 20 or greater indicates a "very poor" subgrade material.

- Add to the end of 618.20 (b) (3) the following:

  Negative group index is reported as zero (0).

  For soils that are non-plastic and when the liquid limit cannot be determined, the group index shall be considered zero (0).

7. **Part 618.26**

- **(b) (1) Flooding frequency class.**
  - ◊ Change the last line of VERY RARE to: ... ***but at least 1 time in 500 years.***
  - ◊ Change OCCASIONAL to: ... ***> 5 to 50 percent chance of flooding in any year or > 5 to 50 times in 100 years.***

- **(b) (2) Flooding duration classes.**
  - ◊ Change to:

Class	***Duration***
Extremely brief	***0.1 to < 4.0 hours***
Very brief	***4 to < 48 hours***
Brief	***2 to < 7 days***
Long	***7 days to < 30 days***
Very long	***≥ 30 days***

- **(d) (4)**
  - ◊ Add to the end of the paragraph: ***Duration is estimated to the nearest hour up to 48 hours, then it is estimated to the nearest day.***

- **(e) Entries**
  - ◊ Add as the 2nd sentence: ***Flooding entries reflect the current existing and mapped condition with consideration for dams, levees, and other man-induced changes affecting flooding frequency and duration.***

8. Part 618.46

- **(b) (2) Ponding frequency class.**
  - ◊ Change:
    NONE - No reasonable possibility of ponding, near 0 percent chance of ponding in any year; less than 1 chance in 100 years.
    RARE - Ponding unlikely but possible under unusual weather conditions; from 1 to 5 percent chance of ponding any year or 1 to 5 times in 100 years.
    OCCASIONAL - Ponding is expected under usual weather conditions; > 5 to 50 percent chance in any year or > 5 to 50 times in 100 years.

- **(c) (2) Ponding duration class.**
  - ◊ Change class limits to:

VERY BRIEF	***< 2 days***
BRIEF	***2 to < 7 days***
LONG	***7 to < 30 days***
VERY LONG	***≥ 30 days***

9. Part 618.61 (b)

- Add to end of paragraph (3): ***When the percent of surface fragment cover is greater than 80 percent, the fragments are then a distinct horizon and also described as a horizon.***

10. **Part 618.71**

- **(a) Definition**. Change to: ***Water, satiated, is the estimated volumetric soil water content at or near zero bar tension, expressed as a percentage of the whole soil.***

- **(b) Significance.** Change 2nd sentence to: ***Satiated water content approximates the water content for the whole soil at saturated conditions.***

- **(b) Significance.** Change last sentence to: ***Correction for fragments is taken into account in calculating this entry.***

- **(c) Estimation.** Change formula to: ***Satiated water % = (total porosity % - entrapped air %) (100 - % volume fragments)***

- **(d) Entries.** Change the valid entries to: ***10 to 70 percent***

11. **Exhibit 627-5 Conventional and Special Symbols Legend, NRCS-SOI-37A**

- Add ***Point and line features*** as soil delineations

- Change definitions on the back of the 37A to:

BLO	***Blowout***	***A small saucer-, cup-, or trough-shaped hollow or depression formed by wind erosion on a preexisting sand deposit. Typically _____ to _____ acres.***
BPI	***Borrow pit***	***An open excavation from which soil and underlying material have been removed usually for construction purposes. Typically _____ to _____ acres.***
CLA	***Clay spot***	***A spot where the surface layer is silty clay or clay in areas where the surface layer of the named soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.***
DEP	***Depression, closed***	***A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and is without a natural outlet for surface drainage. Typically _____ to _____ acres.***
ESB	***Escarpment, bedrock***	***A relatively continuous and steep slope or cliff produced by erosion or faulting, which breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.***
ESO	***Escarpment, other***	***A relatively continuous and steep slope or cliff that generally is produced by erosion but can be produced by faulting, which breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.***

GPI	*Gravel pit*	*An open excavation from which soil and underlying material have been removed and used, without crushing, as a sourve of sand or gravel. Typically _____ to _____ acres.*
GRA	*Gravelly spot*	*A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area of surrounding soil with less than 15 percent fragments. Typically _____ to _____ acres.*
GUL	*Gully*	*A small channel with steep sides cut by running water and through which water ordinarily runs only after a rain or after ice or snow melts. It generally is an obstacle to wheeled vehicles and is too deep to be obliterated by ordinary tillage.*
LDF	*Landfill*	*An area of accumulated waste products of human habitation that can be above or below natural ground level. Typically _____ to _____ acres.*
LAV	*Lava flow*	*A solidified body of rock formed through lateral, surficial outpouring of molten lava from a vent or fissure. Often lobate in shape. Typically _____ to _____ acres.*
LVS	*Levee*	*An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow on lowlands.*
MAR	*Marsh or swamp*	*A water-saturated, very poorly drained area, intermittently or permanently covered by water. Marsh areas are dominantly vegetated by sedges, cattails, and rushes. Swamps are dominantly vegetated by trees or shrubs. Not used in map units where poorly drained or very poorly drained soils are the named components. Typically _____ to _____ acres.*
MPI	*Mine or quarry*	*An open excavation from which soil and underlying material are removed and bedrock is exposed. Also denotes surface openings to underground mines. Typically _____ to _____ acres.*
MIS	*Miscellaneous water*	*Small, man-made water area that is used for industrial, sanitary, or mining applications and contains water most of the year. Typically _____ to _____ acres.*
WAT	*Perennial water*	*Small, natural or man-made lake, pond, or pit that contains water most of the year. Typically _____ to _____ acres.*
ROC	*Rock outcrop*	*An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "bedrock" is a named component of the map unit. Typically _____ to _____ acres.*
SAL	*Saline spot*	*An area where the surface layer has an electrical conductivity of 8 mmhos cm^{-1} more than the surface layer of the named soils in the*

		surrounding map unit, which have an EC of 2 mmhos cm^{-1} or less. Typically _____ to _____ acres.
SAN	*Sandy spot*	*A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils of the surrounding map unit is very fine sandy loam or finer.*
ERO	*Severely eroded spot*	*An area where on the average 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units with component phases that are named severely eroded, very severely eroded, or gullied.*
SLP	*Short, steep slope*	*Narrow soil area that has slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.*
SNK	*Sinkhole*	*A closed depression formed either by solution of the surficial rock or by collapse of underlying caves. Typically _____ to _____ acres.*
SLI	*Slide or slip*	*A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces. Typically _____ to _____ acres.*
SOD	*Sodic spot*	*An area where the surface layer has a sodium adsorption ratio that is at least 10 more than the surface layer of the named soils in the surrounding map unit, which have a sodium adsorption ratio of 5 or less. Typically _____ to _____ acres.*
SPO	*Spoil area*	*A pile of earthy materials, either smoothed or uneven, resulting from human activity. Typically _____ to _____ acres.*
STN	*Stony spot*	*A spot where 0.01 to 0.1 percent of the surface is covered with rock fragments that are greater than 10 inches in diameter in areas where the surrounding soil has no surface stones. Typically _____ to _____ acres.*
STV	*Very stony spot*	*A spot where 0.1 to 3 percent of the surface is covered with rock fragments that are greater than 10 inches in diameter in areas where less than 0.01 percent of the surface of the surrounding soil is covered with stones. Typically _____ to _____ acres.*
WET	*Wet spot*	*A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit. Typically _____ to _____ acres.*

12. Part 629

- Replace Part 629 in total with a 1998 version.

Amendment 5 (September 1999)

This is a summary of major changes made to the NSSH with this amendment. The official copy of the NSSH is the web version. These changes have been incorporated into that version.

1. **Part 601.01**

   - (c) Add to the responsibilities of the state soil scientist the following:
     -- **supplementing and distributing a state subset of the national soil information system data.**
     -- **providing to the responsible MLRA Office, layers desired for map finishing in a compiled or electronic format compatible with digital map finishing. These include such layers as hydrography, public land survey, roads, and recommended cultural features to be used in the survey.**

   - (d) Add to the responsibility of the MLRA office:
     -- **coordinating and providing quality assurance for the map finishing process which may involve doing the job, or coordinating with a state, digital map finishing center, or other entity that does map finishing,**

   - Add part (e) and (f):
     (e) NCSS Responsibilities for the Digitizing Units
     -- **digitizing compiled map materials, and**
     -- **performing quality control of final digital data including spatial, tabular, and metadata.**
     (f) NCSS Responsibilities of the Digital Map Finishing Centers
     -- **electronically preparing soil survey maps for publication.**

   - (g) Add to the responsibilities of NCG:
     -- **providing the process, procedures, and the training to generate map finished products,**

2. **Part 606.02 (f)**

   - Add as the 2nd paragraph the following:
     -- **Indicate whether or not small areas of contrasting soils or miscellaneous areas will be shown on the maps using point and/or line features. This will generally involve mapping such areas at a higher level of detail than the majority of the survey area. Such areas will be identified with map unit symbols and are included in the legend for the survey area.**

3. **Part 606.03 (b)**

   - Revise to read:
     For maintenance of soil areas that have been previously published, the memorandum of understanding is to include the MLRA project plan and evaluations of all the soil surveys. Send these materials to the National Soil Survey Center with a letter requesting the Director, Soil Survey Division, to approve.

4. **Exhibit 606-1 Memorandum of Understanding for a soil survey area.**

- Change the 1st paragraph under Specifications to read:
Map units will be consociations and complexes of phases of soil series. The maximum size of contrasting inclusions in arable map units will be 5 acre areas. If needed by local users, contrasting inclusions of less than 5 acre areas may be shown by use of conventional or special symbols or mapped as point or line segments approved by the MLRA office. The maximum size of contrasting inclusions in nonarable map units will be 10 acre areas. The soils in each delineation will be identified by direct field examination. Systematic traverses will be made in arable map units at an interval close enough to detect 5 acre areas that require significantly different management, and in nonarable map units close enough to detect 10 acre areas.

- Change the 4th paragraph to read:
Field notes will be taken on soil qualities, soil properties, and soil performance to support soil interpretations for cropland, pastureland, windbreaks, rangeland, wildlife habitat, riparian area management, irrigation, rural and community development, recreation, engineering properties, and such groups as hydric soils, highly erodible lands, sodic soils, saline soils, sodic-saline soils, and other soils requiring special management.

5. **Exhibit 607-2 List of Potential Sources of Equipment for Soil Surveys.**

- Add to Ben Meadows:
Phone 1-800-241-6401
Web site www.benmeadows.com

- Add **Ben Meadows** to
Abney level
Altimeter
Area measurement systems
Clinometer
Compass, magnetic
Global positioning systems
Hand lens
Penetrometer
pH kit
pH meter

6. **Part 608.01 (b)**

- Replace this paragraph with the following:
(b) The NRCS policy for and content of other reviews are discussed in the NRCS General Manual Title 340, parts 404.12. 404.13, and 404.14. NRCS conducts three types of reviews: Oversight and Evaluation Reviews, State Quality Reviews, and State Management Reviews. Each type may include soil survey issues.

7. **Part 608.11(b)(1) Initial Field Reviews. (iii) Preparation of the Report.**

   - Revise to read as:
     The leader of the initial field review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Office. Exhibit 608-7 is an example. In addition to the Quality Assurance Worksheet, the report includes:

8. **Part 608.11(b)(2) Progress Field Reviews. (ii) Preparation of the Report.**

   - Revise to read as:
     The leader of the progress field review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Office. Exhibit 608-7 is an example. In addition to the Quality Assurance Worksheet, the report includes:

   - Also revise the 9th included item to read as follows:
     -- a letter transmitting the report, in which the MLRA Leader highlights significant issues and items that are agreed upon; and

9. **Part 608.11(b)(3) Final Field Reviews., (iii) Preparation of the Report.**

   - Revise to read as:
     The leader of the final field review prepares a report of the review. The report includes a "Quality Assurance Worksheet" that has been approved by the MLRA Office. Exhibit 608-7 is an example. In addition to the Quality Assurance Worksheet, the report includes:

10. **Part 608.11(c) Signature and Approval of Field Review Reports., (2)Representatives of cooperating agencies.**

    - Replace "form NRCS-SOI-233" with "**the Quality Assurance Worksheet**" (see Exhibit 608-7)

11. **Part 608.11(c) Signature and Approval of Field Review Reports.,**

    - Add:
      (3) State Conservationist. The State Conservationist has the opportunity to review and sign the report as a means of documenting the transfer of significant issues and agreed to items pertaining to the review.

    - Change: numbering on items (5), (6) and (7) to **(4)**, **(5)**, and **(6)**.

12. **Part 608.14**

    - Delete this section.

13. **Exhibit 608-3 Initial Field Review Checklist.**

    - Item 26. Replace "SOIL-233" with "**Quality Assurance Worksheet**".

14. Exhibit 608-4 Progress Field Review Checklist.

- Item 28. Replace "SOIL-233" with "**Quality Assurance Worksheet**".

15. Exhibit 608-5 Final Field Review Checklist.

- Item 27. Replace "SOIL-233" with "**Quality Assurance Worksheet**".
- Add: **Exhibit 608-7** to subject index and contents

16. Part 617.01

- Add as d, e, f the following:
  (d) The Memorandum of Understanding states which interpretations will be made for a soil survey area. The MLRA office, state soil scientist, and cooperators agree on whether or not to generate interpretations for miscellaneous land types and minor soil components. The Soil Survey Division encourages the entry of data and preparation of soil interpretations for miscellaneous areas. Omission of data elements is by joint consensus of the MLRA office, state soil scientist, and cooperators.
  (e) Completely populate the data elements that are used as criteria in an interpretation in order to generate reliable interpretations.
  (f) Completely populate the data elements for major soil components including map unit components classified as higher taxonomic categories. The MLRA office, state soil scientist, and cooperators should reach a joint decision for special situations where it is not practical to populate data elements for map unit components classified at a higher taxonomic category than soil series. If the range of properties is too wide for interpretations, these areas may not meet the requirements of the user defined needs of the survey.

17. Part 618.04 Albedo.

- Change the formula in part 618.04(d) to read:
  Albedo, dry = (0.07 x dry color value) -0.12

18. Part 618.16 Drainage Class.

- Remove the column of class codes in part 618.16 (e) Entries.

19. Part 618.17 Effective Cation-Exchange Capacity

- Remove the text following the method citation in the definition.

20. Part 618.21 Erosion Accelerated, Kind.

- Remove the columns of codes in part 618.21 (c) Classes
- Eliminate <u>Landslip erosion, highly deformed</u> and <u>Landslip erosion, slightly deformed</u>

- Change (d) to read:
  Entries. Enter the appropriate class for each map unit component. Multiple entries are allowable, but a representative value should be indicated.

21. Part 618.22 Erosion Class.

- Remove the column of codes in part 618.22 (d) Classes.
- Delete "code" in part 618.22 (e)

22. Part 618.23 Excavation Difficulty

- Remove the reference to moisture.

23. Part 618.49 Restriction Kind, Depth, Thickness, and Hardness.

- Remove the column of codes in part 618.49 (a)(2) and part 618.49 (d)(2)
- Also remove the reference to codes in the paragraph preceding the list in part 618.49(a)(2).

24. Part 618.55 Soil Erodibility Factors, USLE, RUSLE.

- Replace the reference to Agriculture Handbook 537 to:
  Agriculture Handbook No. 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), USDA, ARS, 1997.

25. Part 618.56 Soil Erodibility Factors for WEPP

- Change the statement:
  For cropland soils with less than 30 percent sand in part 618.56(a)(4) to read:
  Clay must not exceed 50 percent: if clay is greater, use 50 percent.

26. Part 624 Soil Quality

- Add part 624 to the National Soil Survey Handbook

27. Part 630.03 List of Benchmark Soils

- Add part 630.03(c):
  (c) Access and sort the list of benchmark soils by using the Soil Series Classification (SC) or Official Soil Series Descriptions (OSD) data access search routine. These files are on the National Soil Survey Center website at http://www.statlab.iastate.edu/soils/nsdaf/.

28. Exhibit 630-1

- Change the classification in the examples to:
  fine-loamy, mixed, superactive, frigid Typic Argiustolls for Alpha and
  fine, smectitic, frigid Argiaquic Argialbolls for Beta

29. Exhibit 630-2

- Add the following statement under the exhibit title:
  (To search and sort by taxonomic terms, use the Soil Classification search routine)

- Remove the classification of benchmark soils.

30. Part 655

- Replace part 655 with the 1999 version.

Amendment 6 (April 2001)

This is a summary of major changes made to the NSSH. The official copy of the NSSH is the web version. For paper copies of the handbook, download the updated Word files on the web.

1. **Part 600**

   - Exhibit 600-1

     Replaced reference list with web addresses

2. **Part 602**

   - Exhibit 602-1 Bylaws

     Replaced Article III Section 2.1.2

     Replaced Article VI Section 1.1.5 and Section 1.1.6

3. **Part 606**

   - **Replaced** most of 606.01 concerning policy and responsibility for memorandum of understandings
   - **Removed** 606.02 (a) (2) and **moved** to 608.08 (b) concerning identification codes for surveys
   - **Replaced** 606.03 (a) with change in the submission of MOUs
   - **Other rewrites throughout the part to emphasize exact joins**

4. **Part 610**

   - **Changed** 610.03
   - **Changed** 610.03 (d)
   - **Moved** 610.04 (f) to 610.02 (d)
   - **Changed** 610.07
   - **Changed** 610.08 (a)
   - **Changed** last paragraph of 610.08 (b)
   - **Changed** 610.08 (d)
   - **Revised** Attachment 1 of Exhibit 610-3

- **Revised** 610 to increase emphasis on project surveys as subsets to MLRAs

5. **Part 614**

- **Updated** wording and citations

6. **Part 618**

- **Changed** 618.04 (d) Albedo, Dry
- **Replaced** 618.35 (b) (2) Hydrologic Group with reference to National Engineering Handbook-4
- 618.49 Restriction Kind

  Added Cemented horizon to list of choices for restriction kind

  Changed terminology from horizon to layer
- **Replaced** 618.50 (c) Runoff Classes
- **Revised** 618-53 Slope Length
- **Clarified** estimates of 618.57 Soil Moisture States
- 618.67 Texture Modifier

  Changed (h) (2) (v) naming convention

  Changed (vii) woody fragment reference
- Exhibit 618-3

  Dropped list, referenced to data dictionary
- Exhibit 618-4, 6, 8, 11, and 12

  Added graphics into files
- Exhibit 618-9

  Changed title

  Changed surface features to ped surface features
- Exhibit 618-15

  Removed some terms used in lieu of texture

  Added CEM Cemented to list of Texture Modifiers

7. **Part 622**

- **Removed** reference to Soil Memo 74. Wildlife interpretations are not in effect.
- **Replaced** Exhibit 622-1 with current Code of Federal Regulations
- **Added** Exhibit 622-2 Land Capability Classification Ag. Handbook 210

8. **Part 627**

- **Renamed** this part as Legend Development and Data Collection
- **Replaced** entire Part 627 with rewritten material
- **Reordered** sections
- **Revised** 627.04 (f). A component entry cannot be a surface texture or other phase.
- **Revised** SOI-37A dated June 2000

9. **Part 630**

- **Removed** soil series Tulert from the benchmark list under Nevada

10. **Part 631**

- **Addition** to 631.01 (e)
- **Changed** 631.07 to reflect general changes

11. **Part 644**

- **Moved** contents of 644.08 to second paragraph of 644.04
- **Added** contents of 644.08
- **Incorporated** SOI-7 into Exhibit 644-1
- **Replaced** all references to Electronic Imaging at NHQ
- **Replaced** multiple text throughout the part
- **Updated** taxonomic classes and features list

12. **Part 647**

- **Extensive revisions**

- **Clarified** state responsibility to certify meeting SSURGO standards
- **Clarified** responsibilities for digital map finishing sites
- **Changed** to reflect new 37A
- **Changed** to include point and line soil delineation features
- **Clarified** edit responsibilities
- **Deleted** Checklist for SSURGO Data
- **Renumbered** exhibits
- **Clarified** edit responsibilities in Exhibit 647-3
- **Altered** material in Exhibits 647-5 to 10, revised to correspond with NASIS 5.0

Amendment 7 (May 2001)

This is a summary of major changes made to the NSSH. The official copy of the NSSH is the web version. For paper copies of the handbook, download the updated Word files on the web.

1. Part 629 – Glossary of Landform and Geologic Terms

- Updated the contents.

Amendment 8 (July 2001)

This is a summary of major changes made to the NSSH. The official copy of the NSSH is the web version. For paper copies of the handbook, download the updated Word files on the web.

1. Part 608 – Program Management

- Updated the contents.

National Soil Survey Handbook-Amendment 9 (December 2002)

This is a summary of major changes made to the NSSH. The official copy of the NSSH is the Web version at http://soil.usda.gov/procedures/handbook/main.htm. For paper copies of the handbook, download the updated Word files on the Web.

1. Part 600

Updated Web addresses

2. Part 606

Changed title of part 606.02 to Review, Approval, and Distribution of Memorandum of Understanding.
Revised part 606.01, 606.02, 606.03, Exhibit 606-1, and Exhibit 606-2

3. Part 608

Changed 608.04 title to Limited and Denied Access Areas
Revised part 608.01 and part 608.10
Replaced part 608.04

4. Part 609

Revised Exhibit 609-1

5. Part 610

Revised Part 610.01, 610.02, 610.03, 610.04, 610.05, 610.06
Changed references to National Production Services to National Cartography and Geospacial Center.
Changed title of Exhibit 610-1 to Sample Map Unit Evaluation Sheet
Changed title of Exhibit 610-2 to Soil Survey Area Evaluation Worksheet

6. Part 614

Changed references to Alpha series.

7. Part 618

Revised part 618.50,Exhibit 618-3, Exhibit 618-7 and Exhibit 618-11
Replaced Exhibit 618-16 Wind Erodibility Groups (WEG) and Index

8. Part 624

Changed hyper links

9. Part 627

Revised Part 627.04

10. Part 629

Revised Part 629.02, 629.03, Exhibit 629-1, and Exhibit 629-6

11. Part 630

Changed hyper links
Revised Exhibit 630-1

12. Part 644

Changed reference from National Production Services staff to National Cartography and Geospatial Center.
Revised Part 644.05, 644.06, 644.07, and 644.08
Changed the title of 644.06 to Publishing for Areas with Fewer Users

13. Part 655

Revised Part 655.01

Amendment 10 NSSH December 2003

This is a summary of changes to the NSSH. The official copy of the NSSH is the Web version. For paper copies of the handbook, download the updated Word files on the Web.

Part 606

- **Revised** part 606.02 on procedure to route MOU.
- **Revised** Part 606.04 (f) plans for joining adjacent surveys,

Part 608

- **Revised** part 608.01, 608.11, exhibit 608-5, exhibit 608-7 in the reference to joins.

Part 609

- **Revised** parts 609.04,609.05, 609.06 to define exact and acceptable joins and where to use them.
- **Added** Exhibit 609-2 List of Soil Property or Quality Attributes for Joining

Part 610

- **Revised** exhibit 610-3 to coincide with the definition of an exact join.

Part 614

- **Revised** references to permeability and permeability classes to correspond with elimination of the terminology and replacement by saturated hydraulic conductivity.
- **Revised** exhibit 614-2 in the general content of series description to illustrate neutral color description as N 5/ to coincide with other references.
- **Revised** 614.06 concerning the management of tentative soil series in the OSD and SC files.

Part 618

- **Changed** references to permeability in most all sections to saturated hydraulic conductivity.
- **Changed** reference to the Soil Survey Laboratory Manual to the latest version.
- **Revised** part 618.03 for url for NASIS metadata.
- **Revised** 618.04 Albedo definition to clarify ratio.
- **Revised** 618.23 Excavation difficulty to clarify conditions.
- **Revised** part 618.35 Hydrologic Group. (Major change by engineering division is pending.)
- **Revised** part 618.39 Organic Matter to reflect change in laboratory procedure.
- **Revised** part 618.42 Particle Size to clarify measurement.
- **Revised** part 618.44 Permeability replaced with Saturated Hydraulic Conductivity to reflect the decision to eliminate permeability. Renumbered as part 618.50.

- **Revised** part 618.48 Restriction Hardness to reflect wording in the Soil Survey Manual.
- **Revised** part 618.50 Runoff (renumbered to part 618.49) with new guide to correspond with guide used in the Soil Survey Manual plus addition of overriding conditions. Terminology changed to reflect Soil Survey Manual.
- **Renumbered** parts 618.44 through 618.50 to correspond with drop of permeability.
- **Revised** part 618.68 Water One tenth Bar and part 618.69 Water One-Third Bar to clarify measurement procedures
- **Revised** part 618.72 Wind Erodibility Group and Index to clarify significance and estimates
- **Revised** Exhibit 618-9 Guide for Estimating Ksat from Soil Properties to correspond with guidance in the Soil Survey Manual. (complete change from proposal).
- **Revised** Exhibit 618-10 changed with new values and reference.
- **Replaced** Exhibit 618-16 Wind Erodibility Groups and Index.

Pat 622

- **Revised** 622.07 Forestland and 622.09 Rangeland into one part titled Ecological sites, reordered the other parts that follow.

Part 627

- **Revised** part 627.04 concerning documentation of soils of minor extent.
- **Revised** part 627.05 concerning the naming of components with miscellaneous areas.
- **Revised** 627.05(e), 627.08, 627.09, and exhibit 627-6 to reflect work of the documentation team and changes to ecological correlation procedures.
- **Added** Exhibit 627-8

Part 647

- **Revised** part 647.01, exhibit 647-1, exhibit 647-3 to coincide with the join policy.

Amendment 11 NSSH September 2005

This is a summary of changes to the National Soil Survey Handbook (NSSH). The official copy of the NSSH is the Web version. For paper copies of the handbook, download the updated Word files on the Web. However if the Web version differs from the downloadable copy please inform the NSSH coordinator, gary.muckel@lin.usda.gov.

602 Added regional conference bylaws

607 Survey Preparation

Exh 607-1 added references. Changed some references relating to software and added State Statistical Abstracts as reference.

Exh 607-2 added information on suppliers.

609 Quality Control and Quality Assurance

609.01 Policy and Responsibilities Clarified responsibilities of MLRA offices:

609.06 Field Reviews Reworded to better reflect current policy of conducting within major land resource areas.

609.07 Soil Survey Manuscripts The responsibilities of MLRA office editors were changed.

Exhibit 609-1 Format for Correlation Memorandum. Added statements

610 Maintaining Soil Surveys

References to the "official copy" were changed to official soil survey information. This reflects current policy of providing information electronically.

Information was changed related to reprinting to ordering replica CD-ROMs.

Text in soil survey evaluation was adjusted.

610.00 Changed (b) The purpose of maintaining soil survey information is to ensure current and accurate seamless soil survey information is available to meet the needs of the majority of users.

Part 610.01 Replaced

610.02 (a) Changed to: To prepare a legend for an MLRA, consolidate the soil legends of surveys of the MLRA land resource area." –

610.02 (c) Changed to Update and maintain by major land resource area. Deliver as subsets

610.04 Minor rewording

610.06 Changed the heading and content

610.06 (c) Changed to make revisions to the Soil Data Warehouse for all areas of the soils in the major land resource area.

Exhibit 610-1 Part C: Minor changes

614 Applying Soil Taxonomy. This section was updated to reflect our current policy of entering data to NASIS as metric measurements, and also acknowledges that our classification standard (Soil Taxonomy) uses metric measurements in it's criteria.

Note, this does not impact the use of English units of measure in output products for customers.

614.01 Added responsibility statements for the NSSC

614.04(a) Added sections on regional and national committees

614.05 (c) (1) Minor change made to 614.05 to reference regional soil taxonomy committee to receive proposals.

Exhibit 614-1 Dropped saturated hydraulic conductivity from instructions for first paragraph in OSD.

614.06 Added clarification to the application of soil series

614.06 Dropped differentiae and refer to Chapter 21 of Soil Taxonomy

614.06 (l) Added statement: Field descriptions and official soil series descriptions should use metric units of measurement.

Exh 614-1 Changed example to metric units

Exh 614-2 Changed guidelines to more closely reflect existing policy and practice. Depths and thickness, temperature, precipitation, and elevation are in metric units of measure; legal descriptions, locations, and acreage are in English units. Examples changed to reflect this existing policy and practice.

Exhibit 614-Changed order of redox features to agree with other guidance.

Exhibit 614-2 Change to: "Depths and thickness (cm), temperature (degrees C), precipitation (mm), and elevation (m) are in metric units of measure;" Changed

Exhibit 614-2 Content of Type location- Revised; feet and miles can be used in general location description.

617 Soil Interpretations

National interpretations were introduced and defined as a set of interpretations. This reflects work of the National Soil Interpretations Group

Responsibilities were adjusted reflect current practice.

Material was added to stress the need to populate data to generate interpretations or receive "Not Rated" result.

617.01 Item (h) Added to: maintaining the criteria and templates for state and local interpretations;

617.01 moved policy in part 623.01(a) to part 617:

(f) Completely populate the data elements for major and minor components including map unit components that are higher taxonomic categories or miscellaneous areas.

617.04 Added section on procedure for proposing changes to standard interpretations.

617.05, 617.06, 617.07, and 617.08 Changes incorporated to better reflect current interpretation procedures.

617.10 New section added on procedure for documenting soil interpretation criteria.

617.11 New section added on requirements for naming reports and interpretations.

Exhibit 617-1 Added new exhibit on Example of Descriptions for Documenting Interpretations

618 Changed references to SSIR #42

618.10 Updated the definition of "normal period" from the previously accepted 1961 to 1990 to the current standard of 1971 to 2000 for FFP, MAP, MAAT, and

the Daily Average Potential Evapotranspiration. This agrees with accepted standards of the World Meteorological Organization and is reflected in the current NRCS "Field Office Guide to Climate Data."

618.27 (e) Added for clarification of existing policy: "For example, a flat-shaped rock fragment that is 100 mm x 250 mm x 380 mm has an intermediate dimension of 250 mm, and is not counted as greater than 250 mm. A flat-shaped rock fragment that is 100 mm x 275 mm x 380 mm has an intermediate dimension of 275 mm, and is counted as greater than 250 mm."

618.55 Soil Erodibility Factors, USLE, RUSLE2
Clarification added to point out that saturated hydraulic conductivity (formerly permeability) as used in the erosion equation is for the soil profile. A conversion guide was added relating the permeability class codes of USLE to Ksat values for estimating K factors from the soil erodibility nomograph.

618.57 Soil Moisture Status
(b) The suction break between the nonsatiated wet and satiated wet was corrected to 0.0.
(c) Slight wording changes were made to clarify that soil moisture status refers to map unit component long term information.
(d) Clarification was added to point out the difference between point data (pedon) entrees and the entry for soil moisture status.
(e) Clarification of intent.

618.58 Changed citation to "Landslides Investigation and Mitigation Special Report 247 Transportation Research Board National Research Council 1996" in 2nd paragraph in definition.

Exhibit 618-7 Added footnote to both LL and PI formulas.

622.06 Hydric soils updated reference in (b) Policy to reflect current policy:
(b) Policy. The current criteria for generating a list of hydric soils is in the Federal Register, September 18, 2002, volume 67, number 181, page 58756. The reference for field identification of hydric soils is Field Indicators of Hydric Soils of the United States, Version 5.01 2003. (http://soils.usda.gov/use/hydric).

623 Cancelled part 623. Material incorporated into part 617.

627 Legend and Data Development
- 627.08(e)(4) change citation to 627.03.
- 627.02 (e) Updated references to the former "STATSGO" to "Digital General Soil Map of the U.S."
- 627.03 and Exh 627-1 Emphasis added to use only those miscellaneous areas on the approved list. (This reinforces long-standing policy). Added criteria to define components.
- 627.04 Changed lead in paragraphs.
- 627.06 (e) Depth phases were revised to metric units for consistency.
- 627.08 (d) Added statement: All soil descriptions are to be taken in metric units of centimeters to avoid errors of conversion.

Exh 627-1 Miscellaneous Areas. Added clarification that phase criteria should not be entered in the component field in NASIS. There is a separate field for phase terms. The miscellaneous area "Quarries" was removed from the example list because it is a phase for Pits, and was therefore listed in error.

Exh 627-5. added an electronic Feature and Symbol Legend as a tool.

630 Benchmark Soils-Section rewritten

Exh 630-2 Dropped list of Benchmark Soils by State as part of the NSSH because this is out of date. Current procedure is to maintain the benchmark soil designation in the on-line Soil Classification file and to print current lists from there.

644 Delivering Soil Survey Information

Changed title and content to 644 Delivering Soil Survey Information.
Revised section to reflect current soil survey delivery products.
Modifications were made to parts 644.00 through 644.07 to better reflect the broad scope of soil survey information instead of the previous and outdated orientation to complete, hard copy publications.
Exh 644-1 Added a list of required and optional sections of soil survey publications.
Dropped the Guide for Authors of Soil Survey Manuscripts because it is very out of date with current policy and procedures.

655 Technical Soil Services

655.01 Revised to better reflect current policy and organizational structure.
Added reference to the Soil Data Mart as the official source of soil information.
Added responsibilities for the National Technical Support Centers

This is a summary of changes to the National Soil Survey Handbook (NSSH). The official copy of the NSSH is in html format and MSWord files at http://soils.usda.gov/technical/handbook/.

A new style of formatting is introduced with these revised sections. The following summary points out specific areas where technical content is significantly revised over that of the previous version.

617–Soil Survey Interpretations

617.00(a) .... Points out that interpretations are also used to assist in pre- and post-planning activities for national emergencies.

617.00(f) .... Stresses that National interpretations cannot be modified for state or regional uses because they are designed exclusively for national use across all political boundaries by NRCS and other agencies.

617.01(g) .... ADDED responsibility statements for the National Technology Support Centers, State Soil Scientists, and the NSSC.

617.04(a) .... Assigns the National Technology Support Centers representatives as review coordinators, responsible for coordinating and summarizing all regional feedback, and providing it to the National Leader, Soil Survey Interpretations, for action.
.... Stipulates that the regional soil interpretations coordinating team can either be standing or ad hoc committees within the regional conference committee structure.
.... The National Leader for Soil Survey Interpretations arranges for all NCSS cooperators to be notified of changes that have been made to an interpretation.

617.09(h)(4) .... Contains specific instructions for reporting suspected errors and/or discrepancies in criteria or constructed interpretation logic to the owner of the interpretation, and details of how the interpretation owner will review and evaluate the reported error.

617.11(c)(1) .... Dept. of Homeland Security (DHS) added to the list naming protocols for creating a local interpretation from the National/Standard.

618–Soil Properties and Qualities

618.07 .... Bulk density, 15 bar: The calculations are corrected. The previous calculation was actually for oven dry bulk density, not 15 bar bulk density, and was therefore in error. Soils that are potentially impacted by this change are those with expansive clays.

618.08 .... ADDED: Oven dry bulk density plus a calculation for estimating.

618.27 .... Flooding Frequency, Duration, and Month: The HTML and MSWord files were out of synch; added to MSWord file "*Flooding entries reflect the current existing and mapped condition with consideration for dams, levees, and other man-induced changes affecting flooding frequency and duration.*"

618.32 .... Horizon Depth to Bottom: Corrections are made to comply with 200cm depth of observation–"*Measurement should be estimated to a depth of 200 cm for most soils and to a depth at least 25 cm below a lithic contact if the contact is above 175 cm.*"

618.36 .... Hydrologic Group: Revised to contain general discussion only. The intent of this general discussion is to briefly explain hydrologic groups. For the complete definition and official criteria, users are instructed to go to http://directives.sc.egov.usda.gov/ (U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. National Engineering Handbook, Title 210-VI, Part 630, Chapter 7, Hydrologic Soil Groups. Washington, DC.)

618.39.................Liquid Limit: Specifies that the liquid limit for organic soil material is not defined, and is assigned "null."

618.45.................Plasticity Index: Specifies that the liquid limit for organic soil material is not defined, and is assigned "null."

NSSH 618.49.......Runoff (Index Surface Runoff)–DELETED. The interpretation for Runoff (Index (2006) Surface Runoff), is no longer supported nationally as a standard interpretation. In the survey conducted in 2006, very few states indicated that they still used or had a need for the interpretation. Therefore, the "UTIL-Comparison of Runoff, stored vs. calculated" Pangaea report in NASIS has been set to Ready for Use "No." States are welcome to make a copy of the report if they choose to use it as a local interpretation.

618.56.................Soil Erodibility Factors, USLE, RUSLE2: Establishes the use of "permeability control sections" for determining the K factor of any given mineral soil layer or horizon.

618.68.................Texture Class, Texture Modifier, and Terms Used in Lieu of Texture:

................New criteria differentiates terms used in lieu of texture "highly," "moderately," and "slightly decomposed plant material" from "muck," "peat," and "mucky peat" on the basis of saturation for less than 30 cumulative days versus 30 or more cumulative days.

................New criteria for "mucky" and "peaty" texture modifier to get in synch with definitions in Field Indicators of Hydric Soils of the U.S.:
Used to modify near surface horizons of mineral soils that are saturated with water for 30 or more cumulative days in normal years (or are artificially drained). An example is mucky loam. Excluding live roots, the horizon has an organic carbon content (by weight) of:

- 5 to < 12 percent if the mineral fraction contains no clay; or
- 12 to < 18 percent if the mineral fraction contains 60 percent or more clay; or
- (5 + (clay percentage multiplied by 0.12)) to < (12 + (clay percentage multiplied by 0.10)) if the mineral fraction contains less than 60 percent clay.

................ADDED "highly organic" texture modifier for near surface horizons of mineral soils that are saturated with water for less than 30 cumulative days in normal years and are not artificially drained. Excluding live roots, the horizon has an organic carbon content (by weight) of:

- 5 to < 20 percent if the mineral fraction contains no clay; or
- 12 to < 20 percent if the mineral fraction contains 60 percent or more clay; or
- (5 + (clay percentage multiplied by 0.12)) to < 20 percent if the mineral fraction contains less than 60 percent clay.

................ADDED recommendations from ICOMANTH:

- texture modifiers (i.e., artifactual, very artifactual, extremely artifactual)
- terms used in lieu of texture (artifactual material)

................Woody, grassy, mossy, and herbaceous texture modifiers: ADDED: Along with histic epipedons, these terms are to be used with organic horizons of any thickness that are saturated with water for 30 or more cumulative days in normal years (or are artificially drained), including those in Histels and Histosols, except for Folists.

Exhibit 618-5........Potential Frost Action: Footnotes are revised.

Exhibit 618-9........Guide for Estimating Ksat from Soil Properties: DELETED advice to "use non-carbonate clay". This advice could not be supported in the original intent of Rawls, W.J., and D.L.Brakensiek. 1983. A procedure to predict Green and Ampt. infiltration parameters. In Advances in infiltration. Proc. of the Nat'l Conference on Advances in Infiltration. Dec. 12-13. Chicago, IL.

629–Glossary of Landform and Geologic Terms

This May, 2007 revision includes the vast majority of changes requested since the last official update (2002), especially the subaqueous soils terminology. Questions not resolved at this time will be addressed and incorporated into future versions.

629.02..................Definitions

(a)...........Revised reference codes

(b)...........Clarifying comments attached to glossary terms – revised "colloquial."

(c)...........Revised glossary terms: replaced fluviomarine sediments with fluviomarine deposits.

NSSH Amendment 12	Part 629 Glossary of Landform and Geologic Terms Summary List of Revised Terms	
New terms	**Existing terms – Insertions made**	**Existing terms – Deletions made**
annular drainage pattern	aggradation	anthropogenic feature
artificial drainage pattern	alluvial cone	backswamp deposit
back-barrier beach	anthropogenic feature	bajada
barrier cove	aquiclude	arrier beach
bay bottom	backswamp deposit	barrier flat
centripetal drainage pattern	bajada	barrier island
circular gilgai	arrier beach	beach
coastal marl	barrier flat	beach sands
colluvial apron	barrier island	beach sands
cone karst	beach	break
coral island	beach sands	cove
deflation flat	block field	creep
deranged drainage pattern	block glide	cuesta valley
diatreme	break	cutter [karst]
drainhead complex	cliff	dendritic drainage pattern
dredged channel	climbing dune	deposit
dredge spoils	cove	desert pavement
dredge spoil bank	creep	dune field
dune traces	cuesta	earth pillar
erosional outlier	cuesta valley	estuarine deposit
erosional pavement	cutter [karst]	flute
estuarine subaqueous soils	dendritic drainage pattern	fluviomarine terrace
everglades	deposit	glacier outburst flood
fault block	dip	glaciomarine deposit
fault-block mountains	drainage pattern	hogback
fenster	dune field	igneous rock
filled marshland	earth pillar	lagoon
flatwoods	estuarine deposit	lake
flood-tidal delta	estuary	lowland
fluviomarine bottom	flowtill	marine deposit
fluviomarine deposit	flute	marl
freshwater marl	fluviokarst	paha
glacial groove	fluviomarine terrace	pediment
glaciokarst	glacier outburst flood	polje

NSSH Amendment 12	Part 629 Glossary of Landform and Geologic Terms Summary List of Revised Terms	
New terms	**Existing terms – Insertions made**	**Existing terms – Deletions made**
granitoid	graben	pyroclastic
grady pond	gut	radial drainage pattern
half graben	hogback	radial drainage pattern
homoclinal ridge	homoclinal	reef
homocline	igneous rock	seep
inlet	island	shoal
intertidal	karst	shore complex
karst drainage pattern	karst tower	spoil bank
karstic marine terrace	lagoon	spoil pile
karst lake	lake	strike valley
lagoonal deposit	landform	subaqueous
lava	landslide	submerged - upland tidal marsh
mainland cove	lava flow	talus cone
mangrove swamp	lowland	tidal flat
marine lake [water]	marine deposit	tidal marsh
mine spoil, coal extraction	marl	tilted fault block
pinnate drainage pattern	mud flat	
playette	neck	
point bar [coastal]	outwash fan	
road cut	outwash plain	
sandur	paha	
rectangular drainage pattern	parallel drainage pattern	
relict-tidal inlet	park	
semi-open depression	parna	
slick rock	pavement karst	
slickensides [pedogenic]	pediment	
slickensides [geogenic]	porcellanite	
solution chimney	pyroclastic	
solution pipe	radial drainage pattern	
solution platform	radial drainage pattern	
strike [structural geol.]	reef	
subaqueous landscapes	residuum	
subaqueous soils	sand flow	
submerged back-barrier beach	seep	
thermokarst drainage pattern	shoal	
tidal inlet	shore complex	
toreva block	sinkhole karst	
trellis drainage pattern	slope wash	
tripoli	solution corridor	
valley floor remnant	solution fissure	
volcanic breccia	spoil bank	
washover-fan apron	spoil pile	
washover-fan flat	strath terrace	
washover-fan slope	strike valley	
window [tectonic]	submerged - -upland tidal marsh	
wind-tidal flat	tableland	
zibar	talus cone	

NSSH Amendment 12	Part 629 Glossary of Landform and Geologic Terms Summary List of Revised Terms	
	Existing terms – Insertions made	
	tidal flat	
	tidal marsh	
	till	
	till-floored lake plain	
	valley-border surfaces	
	volcano	
	washover fan	
	wave-built terrace	
	wave-cut platform	
	welded tuff	
	yardang	

629.03..................References were added/revised

Exhibit 629-1........Revised the lists of landscape, landform, microfeature, and anthropogenic feature terms to accommodate revisions in the glossary

Exhibit 629-2........Revised materials or material-related, structure, or morphological-feature terms to accommodate revisions in the glossary

Exhibit 629-3........Revised the list of genesis - process terms and geologic time terms to accommodate revisions in the glossary

Exhibit 629-6........Revised pyroclastic terms

644–Delivering Soil Survey Information, Information Systems

644.01(b) ....ADDED: [The Soil Data Mart] is the official source for soil information delivered through various applications such as the data mart, Web Soil Survey, and field office technical guides.

644.02(a) ....**Official data** is REPLACED with **Official soil survey information** and emphasizes that the official source of soil information is the Soil Data Mart, a part of the National Soil Information System.

(a)(2).......Policy statement added: Initial detailed soil survey information is to be posted when the spatial data is certified, the NASIS data is certified and both databases are ready to send to the Soil Data Warehouse; this is to occur not more than 1 year after mapping is complete.

(c)(1).......ADDED: MLRA Soil Survey Office responsibilities.

644.06(c) ....Approval by the Director of Soil Survey is required for situations in which printed and bound copies are needed.

644.06(b) ....Includes the Web as an electronic source of soil survey information, and the printing of paper copies of the text requires special approval by the Director of Soil Survey.

Exhibit 644-1........ADDED footnote: "As we have progressed to automated development and delivery of soil survey information, taxonomic descriptions (series or higher taxa) are not required for a manuscript to meet minimum standards. Please note that you are not prohibited from publishing these descriptions, including the option to use the OSD. The MLRA regional office leader in the region may have additional insight and suggestions about this."

Exhibit 644-4........DELETED: Purchase Agreement for which the Natural Resources Conservation Service agrees to furnish hard copies of the published soil survey, complete with maps.

647–Soil Map Development

647.00(c) ....Digital data capture: Introduces instruction to field map solely with electronic media and on-screen digitizing as much as possible, which prevents having to compile to orthophotography and hand- or scan-digitize.

............Responsibilities added or modified for the MLRA soil survey offices and state offices.

647.02(a) ....Imagery: New instructions to use the on-line NCGC Ordering System at http://www.ftw.nrcs.usda.gov/ncgcos to acquire imagery and assorted products from the National Cartography and Geospatial Center. The ordering system was developed to streamline the process of ordering products and services from NCGC. The NCGC Ordering System replaces the Carto-19. Items such as imagery and orthophotography, map compilation materials, publication of soil survey products, SSURGO and digital map finishing standards, and status graphics are available through the on-line ordering system.

647.07(d) ....Permanent water and miscellaneous water will conform to soil map unit labels (i.e., alpha, numeric, or alphanumeric).

(e).............Special Labels: Label areas not yet mapped or digitized as part of a progressive survey **NOTCOM**, for not completed.

(h).............Digitizing Specifications–Tabular Attribute Data. Removed all the references to the NASIS tables.

Exhibits ....DELETED Exhibits 647-5 thru 11.

651-Advance Soil Survey Information

651.00(a) ....Defines advance soil survey information as information that has been gathered but is not yet published to the Soil Data Mart. The purpose of providing advance soil survey information is to furnish users with soil maps, interpretations, and other data prior to final correlation of the data.

(b).............Policy statement added from NRCS General Manual, GM 430Part402.5(D): Soil data posted to the Soil Data Mart is official soil information that has been certified for use by the State Soil Scientist in participation with the State Technical Guide Committee for USDA programs.

(c).............Interim reports are obsolete with the advent of the Soil Data Mart and Web Soil Survey.

651.04..................Statements added to help ensure that advance soil survey field sheets and digitized soil map are legible and consistent with adjoining areas, and accompanied with an identification legend, a feature and special symbols legend, and supporting explanatory material.

651.05(b) ....Labeling of Advance Soil Survey Information: A statement must specify that, although advance soil survey information may be correct, it is not official NRCS soil information. Only soil information posted to the Soil Data Mart is official NRCS information.

NSSH Amendment 13
May 2007

This is a summary of changes to the National Soil Survey Handbook (NSSH). The changes reflected in this amendment were introduced to provide policy and guidance in implementing the MLRA Soil Survey Restructuring Plan (previously announced with National Bulletin 430.7.2). Due to the extensive nature of the changes, two rounds of review and comment were conducted between January and April 2007. This summary points out specific areas where technical content has been significantly revised. The official copy of the NSSH is in html format and MSWord files at http://soils.usda.gov/technical/handbook/.

601 – National Cooperative Soil Survey Organization

601.00 – Added paragraph recognizing primary Federal agency partners. Also added Appendix A, which briefly describes each Federal partner agency.

601.01 – List of responsibilities for various offices in the NCSS is expanded and reorganized for better coordination with other sections.

606 – Working Agreements

606.01 – Revised to indicate that only the MLRA Region-wide MOU is required; other forms of MOUs may be developed at the State's discretion and are optional.

606.01(a)(1)(iii) – Added a brief outline for the contents of a MLRA Region-wide MOU.

606.01(e)(1) – Specifies the requirement for each MLRA Soil Survey Office to have a workload analysis – long-range plan, a project plan of operations, and an annual plan of operations.

606.01(e)(2) - Specifies the requirement for each Soil Survey Project Office (conducting initial or extensive update surveys) to have a long-range plan detailing all activities needed to complete the work within about a 5-year period and an annual plan of operations.

Exhibits – Deleted exhibit of county-based MOU since it is no longer required. A brief outline of the contents for this type of MOU was added to 606.01(a)(2)(iii).

607 – Initial Soil Survey Preparation

607.00 – The purpose of this section has been narrowed to only address initial soil survey projects.

607.01 – Roles and responsibilities are updated and coordinated with other sections. Also, the need for conducting initial soil survey projects in a coordinated fashion within the context of the larger MLRA region is stressed.

607.02(c) – Added information about preparation of a digital data mapping base. Also, added an example (exhibit 2) of a geodatabase development procedure. This is presented as an example that can be modified to fit local needs.

Previous exhibit listing equipment suppliers was deleted because it was not current and is not needed today. Internet search engines fill this need.

608 – Program Management

608.01 – Responsibilities for each organizational level are updated. The section describes MLRA Soil Survey Offices (601.01(g)) and Soil Survey Project Offices (601.01(h)).

608.01(h) – Specifies that Soil Survey Project Offices (as opposed to MLRA Soil Survey Offices) are established only with the concurrence of the Soil Survey Division Director.

608.01(e) – Specifies that State Soil Scientists (not MO Leaders) supervise Soil Survey Project Leaders unless the Board of Directors assigns supervision to the MLRA Regional Office Leader.

Information on field reviews is moved to part 609.

608.04(b) – Recognizes that the considerations expressed by Native Americans regarding privacy of Tribal lands, or national security concerns, are acceptable reasons to not pursue methods to complete surveys where access is denied.

608.05 – Describes the concept of a "workload analysis – long-range plan" and a "project plan of operations" for MLRA Soil Survey Offices.

608.08 – This section on managing the Soil Survey Schedule is revised to fit the program as it currently exists (which does not yet adequately accommodate management of soil surveys by MLRA).

608.08(g) – We are no longer using "maintenance" as a term for soil survey area status.

Exhibits are revised and updated to better reflect current business processes.

609 – Quality Control, Quality Assurance, and Soil Correlation

Title revised by adding "Soil Correlation".

609.00 – Quality control and quality assurance definitions are revised and expanded.

609.01 - Responsibilities for each organizational level are updated. Includes clarification that the MLRA Soil Survey Office periodically conducts quality control reviews, and the MLRA Regional Office conducts quality assurance reviews.

609.02 (e) – Clarifies that correlation documents are created for initial soil surveys only. Amendments to existing correlation documents are prepared only up until the time that a survey area is SSURGO certified. From that point forward, correlation decisions are recorded in NASIS, but amendments are not prepared. Also, deleted the requirement for adding farm bill lists (hydric, highly erodible, etc) as attachments to correlation documents.

609.04 – This is a new section describing quality control reviews, including a new exhibit (exhibit 609-10).

Exhibit 609-2, "List of properties and quality attributes for joining," is updated.

All other exhibits are updated to reflect current processes.

610 – Updating Soil Surveys.

The term "maintenance" is replaced with "update," including its use in the title of this section.

610.01 - Responsibilities for each organizational level are updated.

610.01(b)(1)(i) - This indicates that MO's and States are to coordinate to develop plans for routine updating of existing NASIS datasets.

610.02 – This is a new section on workflow for updating by MLRA.

610.04 – Provides guidance for developing a workload analysis – long-range plan, a project plan of operations, and an annual plan of operations.

610.05 – This is a new section on NASIS legend management.

610.06 – This is a new section on managing soil spatial and tabular databases.

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Soils

National Soil Survey Handbook (NSSH)

The National Soil Survey Handbook is a subdivision of the NRCS directives system. The NSSH provides operational and procedural policy and guidance for the soil survey program.

Soil survey staff at the National Soil Survey Center in Lincoln, Nebraska, are primary authors to this handbook.

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Links

(Also located in the menu on the left)

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