



United States
Department of
Agriculture

Soil Survey Manual

Soil Science Division Staff



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Agriculture

Soil Survey Manual

By Soil Science Division Staff

United States Department of Agriculture
Handbook No. 18

Issued March 2017

Minor Amendments February 2018

This manual is a revision and enlargement of U.S. Department of Agriculture Handbook No. 18, the *Soil Survey Manual*, previously issued October 1962 and October 1993. This version supersedes both previous versions.

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Introduction to the Fourth Edition

**By Craig Ditzler, Kenneth Scheffe, and H. Curtis Monger,
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The *Soil Survey Manual*, USDA Handbook No. 18, provides the major principles and practices needed for making and using soil surveys and for assembling and using related data. The term “soil survey” is used here to encompass the process of mapping, describing, classifying, and interpreting natural three-dimensional bodies of soil on the landscape. This work is performed by the National Cooperative Soil Survey in the United States and by other similar organizations worldwide. The Manual provides guidance, methodology, and terminology for conducting a soil survey but does not necessarily convey policies and protocols required to administer soil survey operations. The soil bodies contain a sequence of identifiable horizons and layers that occur in repeating patterns in the landscape as a result of the factors of soil formation as described by Dokuchaev (1883) and Jenny (1941). Soil scientists gain an understanding of the factors of soil formation in their area, along with the resulting expression of their interaction in the soil, and are then able to make maps of the natural soil bodies quite efficiently (Hudson, 1992). The maps of soil bodies are related to, but different from, maps of single soil properties, such as organic matter or pH. The latter are made by sampling and statistical modeling to show how these properties vary over the landscape.

Purpose

The Manual is intended primarily for use by soil scientists engaged in the work of making soil surveys. It is an especially important reference for soil scientists early in their careers as they learn the many complex aspects of making a soil survey. It is also an important reference for experienced soil surveyors who want to review the details regarding many of the standards used in soil survey. For example, chapter 3, “Examination and Description of Soil Profiles,” contains the accepted

terms and definitions for specific soil properties that are used when describing soil profiles in the field. It also contains extensive information describing each soil property and the proper procedures for observing or measuring it in the field. The Manual is therefore an important companion to other soil survey references, such as the National Soil Survey Handbook (USDA-NRCS, 2016), the Field Book for Describing and Sampling Soils (Schoeneberger and Wysocki, 2012), and the Keys to Soil Taxonomy (Soil Survey Staff, 2014).

Although the Manual is oriented to the needs of those actively engaged in preparing soil surveys, workers and students who have limited soil science experience or are less familiar with the soil survey process can also use the information. Teachers, researchers, and students of soil science and related disciplines, especially those interested in pedology, soil morphology, soil geography, ecology, geomorphology, and the science underlying soil survey, will find this manual useful. Resource specialists, such as wetland scientists, foresters, and agronomists, and others who use soil surveys in their work, can refer to the Manual to better understand how soil surveys are made and how to interpret the technical information they provide. Parts of the Manual, especially those concerning the description of soils in the field and the soil properties considered when predicting soil behavior under a specific use, have been adopted by private-sector soil scientists as standards. The *Soil Survey Manual* has proven to be an important source of information for government agencies, nongovernmental organizations, and private-sector resource specialists in other countries involved in soil survey projects. Because the Manual describes all facets of the soil survey process, it is an important guide for developing proposals to conduct soil surveys and to create detailed plans for projects in other parts of the world.

The Manual serves as the guiding document for activities of the National Cooperative Soil Survey (NCSS), a cooperative undertaking led by the United States Department of Agriculture. The NCSS includes other Federal and State agencies, universities, non-governmental organizations, and private-sector soil scientists interested in making soil surveys and/or interpreting and using soil survey information. The original Federal authority for the Soil Survey of the United States is contained in the record of the 53rd Congress, Chapter 169, Agricultural Appropriations Act of 1896. The authority was elaborated in Public Law 74-46, the Soil Conservation Act of April 27, 1936, and again in Public Law 89-560, Soil Surveys for Resource Planning and Development, September 7, 1966. The Manual is the primary reference on the principles and technical details used by the local, State, and Federal contributors to soil surveys authorized under these acts.

Need for Additions and Revisions

Since the third edition (1993) of the Manual was printed, significant changes have occurred that affect the ways soil surveys are made. In the United States, greater emphasis is now placed on the maintenance and modernization of previously completed soil surveys. Because of this, some soil scientists are now evaluating and improving existing surveys rather than making new soil surveys. The wide application of computer technology, in both the office and the field, has led to a proliferation of electronic data sources, including digital elevation models (DEMs), Light Detection and Ranging (LiDAR), digital geology maps and vegetation maps, and multi-spectral remote sensing data. The electronic data sources, combined with computer models that capture and apply knowledge of the interaction of the soil-forming factors, have allowed soil scientists to partially, and in a few cases totally, automate the soil mapping process. This has had an important impact on the scientist's ability to formalize and document the soil-landscape models used to produce soil survey maps. It has also led to improved consistency in the maps produced using these methods. In addition, tools used for proximal sensing of soil properties, such as ground-penetrating radar and electromagnetic induction, have been increasingly used in special soil survey field studies. Greater attention is also being given to recognizing anthropogenic influences on soils. This has resulted in a need for the development of new standards for horizon nomenclature for human-altered soils, new terminology for describing human-made materials (artifacts) in soil profiles, and new classification groups. Soil surveys have also been conducted to a greater extent in shallow water (subaquatic) environments. New field procedures, descriptive terms, and taxonomic classes have been developed for conducting this innovative work.

Because of these changes, a major revision of the Manual was considered essential. Many parts have been revised, some parts have been extensively rewritten, and some new sections have been added. Entirely new subject matter in this edition of the Soil Survey Manual includes:

- Chapter 5, "Digital Soil Mapping." This chapter presents many concepts and principles that have been developed regarding the use of computers and digital technology to aid in the making of soil surveys.
- Chapter 6, "Tools for Proximal Soil Sensing." This chapter covers recent advances in the use of noninvasive tools for rapidly collecting information about soil properties.

- Chapter 9, “Assessing Dynamic Soil Properties and Soil Change.” This chapter provides important information for documenting key soil properties, particularly in the near surface layers that are significantly impacted by soil management practices.
- Chapter 10, “Subaqueous Soil Survey.” This chapter covers the emerging specialized field of making soil surveys in shallow water environments. This work is proving to be highly valuable to resource managers, especially in coastal estuarine environments.
- Chapter 11, “Human-Altered and Human-Transported Soils.” This chapter provides valuable guidance on making soil surveys in environments heavily impacted by humans. Examples include urban areas, mined sites, and drastically changed soils used for agriculture.
- Appendices. The new appendices reflect the current form and content of web-accessible soil survey information in the United States. They are cross referenced in various places throughout the text.

Other significant revisions include:

- The former chapter 3 (“Examination and Description of Soils”) is now split into two chapters: “Landscapes, Geomorphology, and Site Description” (chapter 2) and “Examination and Description of Soil Profiles” (chapter 3). This effectively separates the details for describing landscapes, geomorphology, and local site characteristics from the details for describing individual soil profiles. Both chapters incorporate all of the changes and additions to standard technical terms and their definitions that have been adopted by the National Cooperative Soil Survey since the previous publication of the Manual.
- The former chapters 2 (“Soil Systematics”) and 4 (“Mapping Techniques”) are combined and revised into a new chapter 4, “Soil Mapping Concepts.” Information in the previous edition on procedures that have since become obsolete or nearly so (such as the use of stereoscopes and aerial photo pairs to visualize landforms in three dimensions, “color checking” to manually inspect maps for proper joining of units, and use of dot-grids to determine the aerial extent of map units) has been omitted.
- The former chapters 5 (“Information Recording and Management”) and 7 (“Disseminating Soil Survey Information”) are revised and updated into the new chapter 7, “Soil Survey Data Collection, Management, and Dissemination.” The new chapter discusses the use of computer databases to effectively

store and manage soil survey information as well as provide information to end users. It also includes a historical summary of the development of the National Soil Information System (NASIS) in the United States. The summary may be useful to those outside the U.S. who are considering the development of a similar database.

- The former chapter 6 (“Interpretations”) is revised and updated into the new chapter 8 (“Interpretations: The Impact of Soil Properties on Land Use”). The new chapter describes some of the latest strategies for making current interpretations more quantitative and providing interpretive information for anticipated uses.

Online Access

Given the rapid pace of technological change, flexibility is needed to provide information in a timely manner. In addition to a bound, hard-copy version of the *Soil Survey Manual*, a web-based version is also provided. The electronic version has convenient access and distribution of the information, and it affords users the option to “print on demand” individual parts or the entire document. The user can view each section of the Manual as a stand-alone chapter or view the entire document. The sections are arranged to correspond to the approximate chronological order of the work required to complete a soil survey. The reader has the choice of focusing on individual parts of interest or exploring the larger picture of conducting a soil survey project from beginning to end. Additional supplementary information not provided in the printed version will be included with the electronic version.

Citation and Authorship

The previous edition of the *Soil Survey Manual* (Soil Survey Division Staff, 1993) simply listed the author as the Soil Survey Division Staff. The contents of the Manual represented the collective contributions of many people over several decades. The new edition continues to recognize the innumerable past contributors by including the Soil Science Division Staff as an author for chapters that retain significant portions of the previous publication. These chapters contain information that has been used for decades as well as new information related to improved methods and/or new terminology. For the updated chapters, authors responsible for

revisions are listed in addition to the Soil Science Division Staff. For entirely new chapters, only individual contributing authors are cited by name. Technical content of the Manual was revised and edited by Craig Ditzler, Kenneth Scheffe, and H. Curtis Monger. English content was revised and edited by Jennifer Sutherland and Aaron Achen.

Recommended Citations

For individual chapters, provide authors and chapter title. For example:

Adamchuk, V.I., B. Allred, J. Doolittle, K. Grote, and R.A. Viscarra Rossel. 2017. Tools for proximal soil sensing. *In* C. Ditzler, K. Scheffe, and H.C. Monger (eds.) Soil survey manual, USDA Handbook 18, Government Printing Office, Washington, D.C., pp. 355–394.

For the complete manual:

Soil Science Division Staff. 2017. Soil survey manual. C. Ditzler, K. Scheffe, and H.C. Monger (eds.). USDA Handbook 18. Government Printing Office, Washington, D.C.

Acknowledgements

The following individuals provided valuable assistance in the development and review of this edition of the Manual: Tim Warner, West Virginia University; Colby Brungard, New Mexico State University; Katey Yoast, USDA Food and Nutrition Service; Christopher Dorian, private consultant; and Natural Resource Conservation Service employees W. Dwain Daniels, Tony Jenkins, Dylan Beaudette, Julie Baker, Tammy Umholtz, Robert Long, Thomas D’Avello, Travis Nauman, Jessica Philippe, and Stephen Roecker.

Seminal contributions were made during the 1954 to 1977 era of field-based soil-geomorphic research projects in Iowa, New Mexico, North Carolina, Oregon, and West Texas. These projects were sponsored by the SCS Soil Survey Investigations Division (SSI) under the direction of G.D. Smith. SCS-SSI scientists who investigated fundamental soil-geomorphic principles in these projects included geologists R.V. Ruhe, J.W. Hawley, and C. Balster and pedologists L.H. Gile, R.B. Grossman, F.F. Peterson, R.B. Daniels, E. Gamble, J.E. Witty, W.C. Lynn, W.D. Nettleton, and R. Parsons.

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