SECTION II – NATURAL RESOURCES INFORMATION

PART 1. SOIL AND SITE INFORMATION

Table of Contents

Subject Index

Introduction

- Available Products and Information about Vermont Soil Survey Program
- NRCS Office Locations and Contacts in Vermont

Section II of the Field Office Technical Guide provides information about the soils. This information, which includes soil maps, soil descriptions, soil properties data, and soil interpretations, is required in the administration of many Natural Resources Conservation Service (NRCS) programs and is useful to the general public in making decisions about land use and management.

Soil survey information is intended to be used as a planning tool and should not take the place of on-site investigations that are required for NRCS programs or by federal, state, or local laws and regulations.

Soil survey information is available from a variety of sources in several formats. Traditional published soil surveys are available for some counties. Other counties have interim soil survey reports. These interim reports are subject to change as the soil mapping is completed.

Digital soil survey information, including spatial data and soil properties and interpretations data, is available in two formats: SSURGO and Vermont data.

The publication date of the soil survey relates to its usability. Soil surveys with the most current publication date are the most usable. Soil Survey evaluation sheets and certification statements are filed in section II-i.

Section II Maintenance Policy

Most information in Section II is available as either WORD or EXCEL documents. A copy of this information will be supplied to each field office on CDROM or disk and will become available on the soil survey web page. Hard copies of this information are filed in Section II at the discretion of the District Conservationist.

Any information that is not available as electronic files must have a paper copy filed in Section II. This information includes:

- GENERATE LIST

Vermont Cooperative Soil Survey
Available Products and Information
March 2002

The soils information listed below is available from the Vermont Cooperative Soil Survey Program. Instructions on how to obtain information is included.

Soil Mapping

Soil mapping has been completed for Addison, Bennington, Chittenden, Franklin, Grand Isle, Lamoille, Orange, Orleans, Rutland, Washington, Windham and Windsor Counties. Soil mapping activities are ongoing in Caledonia and Essex Counties. The scheduled completion dates for the remaining surveys are: Caledonia County - 2004, and Essex County - 2009.

Published Soil Survey Reports

Published soil surveys are available for Chittenden, Franklin, Lamoille, Orange, Rutland, and Windham Counties. The published soil surveys are out of print and not available for Addison and Grand Isle Counties.

There is a large backlog of soil surveys nationwide awaiting publication at the Government Printing Office (GPO). NRCS has been working on improving and speeding up the soil survey publication program. Bennington, Washington, and Windsor Counties will be published as the backlog is eliminated.

NRCS in Vermont will continue to work with the Natural Resource Conservation Districts to produce interim soil survey reports to meet our customers needs until the GPO soil survey is published. Interim soil survey reports are available for Bennington, Caledonia, Washington, and Windsor Counties. The Conservation Districts charge a fee for these reports.

Digital Soil Surveys

Digital soil surveys are available for Addison, Bennington, Chittenden, Franklin, Grand Isle, Lamoille, Orange, Rutland, Washington, Windham and Windsor Counties. The Chittenden and Grand Isle County soil surveys have not been throughly checked and data quality is uncertain. Windsor County data is in the process of being certified. A CD of Vermont Soil Data for these 11 counties is available through the Vermont Center for Geographic Information (VCGI). These surveys are available with Vermont orthophotos as the base map.

Digital soil surveys are also available in the Soil Survey Geographic database (SSURGO) format, which is in UTM projection with USGS 7.5 minute quadrangles used as the base map, for the following counties: Addison, Bennington, Franklin, Lamoille, Orange, Rutland, Washington, and Windham. Windsor County should be available sometime in 2002. SSURGO data is available from the National Cartography and Geospatial Center in Fort Worth, Texas.

Soil Survey Digital Attribute Databases

Soil characteristics and interpretations are available in a database for all counties in Vermont as part of the digital soil surveys. This information can be obtained from the Vermont Center for Geographic Information at 802-656-4277. Questions about these databases should be directed to Martha Stuart, Soil Database Specialist, in White River Junction, VT, 05001, at 802-295-7942, ext. 28.

General Soil Maps

General soil maps are available for most counties in Vermont. A digital state general soil map (STATSGO) is available from the National Cartography and Geospatial Center or from the Vermont Center For Geographic Information. The map scale of STATSGO is 1:250,000. An updated version of the Vermont STATSGO map will be available sometime in 2002.

How to Obtain Information

The location, addresses and telephone numbers of the NRCS state office and field offices are attached. To obtain local soil survey information, contact the office that serves the county of interest. The state office in Colchester has copies of published soil surveys and access to the databases listed above.

To obtain digital soil survey information, contact the National Cartography and Geospatial Center at 817-509-3400 or the Vermont Center for Geographic Information at 802-656-4277. Questions about the digital soil surveys should be directed to Caroline Alves, GIS Specialist, in Williston, VT at 802-879-4785, ext. 23 (currently on academic leave) or Bob Long, Soil Survey Project Leader, in Newport, VT at 802-334-6090.

Downloading Electronic Data

Vermont Soil Survey Data
Some soil survey information for Vermont is available on the Internet. Log on to the VT NRCS home page at **http://www.vt.nrcs.usda.gov** and click on "Soil Survey Information". The site will be expanded over the next few years.

NRCS Data Clearing House **http://www.ncg.nrcs.usda.gov/nsdi_node.html**
This site is linked to information about Base Maps, Map Library, National Resources Inventory, Plants, Soils, Status Maps, Water and Climate, Watershed Boundaries, and Geospatial Data Clearing Houses.

NRCS Data Resources **http://www.ftw.nrcs.usda.gov/soils_data.html**
This site is linked to the Map Unit Interpretation Database (MUIR), National Soil Survey Lab Data, the National Soil Data Access Facility, NASIS, the National Soil Survey Handbook, Official Soil Series Descriptions, Soil Classification Database, SSURGO data, the Soil Survey Manual, and STATSGO data.

NRCS National Soil Survey Center **http://www.statlab.iastate.edu/soils/nssc/**
This is the home page for the National Soil Survey Center which provides technical leadership and coordination for the soil survey program in NRCS. Click on either “Soils Information and Data” or “Standards of Soil Survey”.

Vermont Center For Geographic Information **http://geo-vt.uvm.edu/**
This site has access to digital soil surveys and other geospatial data.

Other Web sites of interest

NRCS **http://www.nrcs.usda.gov**
This is the home page for the Natural Resources Conservation Service.

NRCS Soil Survey Division **http://www.statlab.iastate.edu/soils/soildiv/**
This is the home page for the Soil Survey Division which oversees soil survey activities in NRCS.

NRCS Vermont Office Locations

STATE OFFICE

356 Mountain View Drive, Suite 105 — **Telephone:** 802/951-6796
Colchester, VT 05446 — **FAX:** 802/951-6327

Stephen H. Gourley	State Soil Scientist	Ext: 236	Steve.Gourley@vt.usda.gov

FIELD OFFICES

BENNINGTON - Bennington County — **Telephone:** 802/442-2275
C/O Bennington County NRCD — **FAX:** 802/447-1934
310 Main St.
P.O. Box 505
Bennington, VT 05201

Jennifer M. Kimberly	District Conservationist		Jennifer.Kimberly@vt.usda.gov

BERLIN - Washington and Orange County — **Telephone:** 802/828-4493
617 Comstock Road, Suite 1 — **FAX:** 802/223-6163
Berlin, VT 05602-8927

Bruce P. Chapell	Resource Conservationist	Ext: 104	Bruce.Chapell@vt.usda.gov

Orange County (and White River NRCD in Windsor County)

Daniel S. Koloski	Soil Conservationist	Ext. 100	Daniel.Koloski@vt.usda.gov

BRATTLEBORO - Windham County — **Telephone:** 802/254-9766
28 Vernon Street, #2 — **FAX:**802/254-3307
Brattleboro, VT 05302-8605

Drew Adam	District Conservationist	Ext: 101	Drew.Adam@vt.usda.gov

MIDDLEBURY - Addison County — **Telephone:** 802/388-6748
68 Catamount Park, Suite B — **FAX:** 802/388-3709
Middlebury, VT 05753

Keith D. Hartline	District Conservationist	Ext: 27	Keith.Hartline@vt.usda.gov

MORRISVILLE - Lamoille County — **Telephone:** 802/888-4935
109 Professional Drive, Suite 2 — **FAX:**802/888-8901
Morrisville, VT 05661

Charles T. Mitchell	District Conservationist	Ext: 12	Charles.Mitchell@vt.usda.gov

NEWPORT - Orleans County — **Telephone:** 802/334-6090
59 Waterfront Plaza, Suite 12 — **FAX:** 802/334-1365
Newport, VT 05855-4877

David Blodgett	District Conservationist	Ext: 25	David.Blodgett@vt.usda.gov

Soils Staff

Robert F. Long	Soil Survey Project Leader	Ext: 20	Robert.Long@vt.usda.gov
Carinthia A. Grayson	Soil Scientist	Ext: 19	Carinthia.Grayson@vt.usda.gov

RUTLAND - Rutland County — **Telephone:** 802/773-803, **FAX:** 802/773-4177
170 South Main Street, Suite 6
Rutland, VT 05701

William R. Forbes	District Conservationist	Ext: 14	William.Forbes@vt.usda.gov

ST. ALBANS - Franklin and Grand Isle Ctys. — **Telephone:** 802/524-6505, **FAX:** 802/524-4575
27 Fisher Pond Road, Suite 1
St. Albans, VT 05478

David K. Hoyt	District Conservationist	Ext: 122	Dave.Hoyt@vt.usda.gov

ST. JOHNSBURY - Caledonia and Essex Ctys. — **Telephone:** 802/748-2641, **FAX:** 802/748-1621
1153 Main St., Suite 2
St. Johnsbury, VT 05819

Timothy F. McKay	District Conservationist	Ext: 109	Timothy.McKay@vt.usda.gov
Soils Staff			
Roger G. DeKett	Soil Survey Project Leader	Ext: 111	Roger.DeKett@vt.usda.gov

WHITE RIVER JUNCTION - most of Windsor Cty — **Telephone:** 802/295-7942, **FAX:** 802/296-3654
28 Farmvu Drive
White River Jct., VT 05001

Windsor County-Ottauquechee NRCD			
Dana G. Young	District Conservationist	Ext: 20	Dana.Young@vt.usda.gov
Soils Staff - Regional/Statewide Responsibilities			
Thomas R. Villars	Soil Resource Specialist	Ext: 24	Thomas.Villars@vt.usda.gov
Martha H. Stuart	Soil Database Specialist	Ext: 28	Martha.Stuart@vt.usda.gov

WILLISTON - Chittenden County — **Telephone:** 802/879-4785, **FAX:** 802/879-3920
600 Blair Park, Suite 230
Williston, VT 05495-7529

Michael R. Fornier	Resource Conservationist	ext: 24	Michael.Fornier@vt.usda.gov
Soils Staff - Statewide Responsibilities			
Caroline M. Alves*	Soil Scientist/GIS Specialist	ext: 23	Caroline.Alves@vt.usda.gov

*On academic leave 9/2001-9/2002

LANCASTER, NEW HAMPSHIRE — **Telephone:** 603/788-4651, **FAX:** 603/788-2538
4 Mayberry Lane
Lancaster, NH 03584

Soils Staff - Serving Northeastern Vermont			
Joe Homer	Soil Resource Specialist	ext: 16	jhomer@nh.nrcs.usda.gov

Section II-i Soil Legends

This section contains information about the official copy of the soil survey, evaluation of the current soil survey, certification statements on the use of soil survey information, and the current soil survey legend.

The following is filed in this section:

- Soil Survey Legend – This is a list of the map units that are mapped in the soil survey.
  File – **legend0xx.xls** – **0xx =** county fips code

- Soil Survey Evaluation Sheets – This contains a history of the soil survey, evaluation of the soil survey legend, maps, and interpretations, and a list of needs to update the soil survey.
  File **–** **Soil Survey Evaluation Sheet 0xx.xls** – **0xx** = county fips code

- Official Copy of the Soil Survey – This contains an explanation of the official copy of the soil survey and the policy for updating it.

- Soil Survey Certification Statements – These are certification statements on the use of soil survey maps, data, and interpretations.

- State Soil Survey Legend - The state soil survey legend is used by Soil Resource Specialists and others to conduct site-specific mapping in the state.
  - **Narrative for Vermont State Soil Survey Legend**
  - **Vermont State Soil Legend,** alphabetically by map unit name

Section II-ii-A   Non-technical Soil Descriptions

In this section, the map units are described. Map unit descriptions can be found in published soil surveys, the Soil Survey Handbook for soil surveys that are in progress, soil survey fact sheets, or they can be generated from Soil Data Viewer in Customer Tool Kit.

The following is filed or referenced in this section:

- Detailed map unit descriptions – map unit descriptions contain information about the map unit including use and management concerns.
- Soil survey fact sheets – contains map unit information commonly requested by customers.
- Soil Data Viewer non-technical map unit descriptions – see information on the use of Soil Data Viewer in Customer Tool Kit information.

Section II-ii-B Technical Soil Descriptions

In this section, each soil series mapped in the survey area is described. Characteristics of the soil and the material in which it is formed are identified for each series. The soil is compared to similar soils nearby soils of other series. A typical pedon is described and classified following standards in the soil survey manual and Soil Taxonomy. The range in important characteristics of the soil series in the survey area is described.

The following is filed or referenced in this section:

- Technical Soil Descriptions (Taxonomic Descriptions)
- Survey area catena key. File - **cat0XX.xls**, **0XX** = county FIPS code.

Section II-iii Use and Explanation of Soil Interpretations

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Soil interpretations will not eliminate the need for onsite study and testing of specific sites for specific uses. They can be used as a guide to planning more detailed investigations and for avoiding undesirable sites for an intended use.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called non-contrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Berkshire fine sandy loam, 3 to 8 percent slopes, very stony is a phase of the Berkshire series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Tunbridge-Lyman complex, 8 to 15 percent slopes, very rocky is an example.

An association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Hogback-Rawsonville association, hilly is an example.

An undifferentiated group is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Markey-Wonsqueak soils, 0 to 2 percent slopes is an example.

Miscellaneous areas have little or no soil material and support little or no vegetation. Urban Land is an example.

Explanation of Key Phases Used in Soil Interpretations

Soil interpretations typically list the degree of limitation or suitability and factors affecting use of the soil for agricultural and nonagricultural purposes. The interpretations apply to the soils in their natural site (unless indicated otherwise) and not for areas that are altered by cut-or-fill operations.

Limitation and suitability terms used are as follows:

- Slight or Good – relatively free of limitations or limitations are easily overcome.
- Moderate or Fair – limitations need to be recognized, but can be overcome with good management or careful design.
- Severe or Poor or Very Poor – limitations are difficult or costly to overcome

Some key phrases used in Section II are as follows:

- **Area reclaim.** - An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.
- **Available water capacity (available moisture capacity).** - The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:
- **Complex slope.** - Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.
- **Cutbanks cave.** - The walls of excavations tend to cave in or slough.
- **Deep to water.** - Deep to permanent water table during the dry season
- **Dense layer.** - A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.
- **Depth, soil.** - Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.
- **Depth to rock.** - Bedrock is too near the surface for the specified use.
- **Droughty** - Soil cannot hold enough water.
- **Dusty** - Soil particles detach easily and cause dust.
- **Erodes easily** - Water erodes soil easily.
- **Erosion.** - The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
- **Excess fines.** - Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.
- **Excess humus.** - Contains too much organic matter.
- **Excess lime.** - Excess carbonates in the soil that restrict the growth of some plants.
- **Fast intake.** - The rapid movement of water into the soil.
- **Favorable.** - Features of soil are favorable.
- **Flooding.** - A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.
- **Fragile.** - A soil that is easily damaged by use or disturbance.
- **Frost action.** - Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
- **Hard to pack.** - Difficult to compact.
- **Large stones.** - Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.
- **Leaching.** - The removal of soluble material from soil or other material by percolating water.
- **Low strength.** - The soil is not strong enough to support loads.
- **No Water**. - Too deep to ground water.
- **Percs slowly.** - The slow movement of water through the soil adversely affects the specified use.
- **Piping.** - Formation of subsurface tunnels or pipe-like cavities by water moving through the soil.
- **Ponding.** - Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.
- **Poor filter.** - Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.
- **Poor outlets.** - Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.
- **Rooting depth.** - Shallow root zone. The soil is shallow over a layer that greatly restricts roots.
- **Runoff.** - The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.
- **Seepage.** - The movement of water through the soil. Seepage adversely affects the specified use.

- **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 great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
- **Slow intake.** - The slow movement of water into the soil.
- **Slow refill.** - The slow filling of ponds, resulting from restricted permeability in the soil.
- **Small stones.** - Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.
- **Soil blowing.** - Soil easily moved by the wind.
- **Subsides.** - Settling of organic soils or of soil containing semi-fluid layers.
- **Thin layer.** - Otherwise suitable soil material that is too thin for the specified use.
- **Too acid.** - Soil is so acid that growth of plants is restricted.
- **Too arid.** - The soil is dry most of the time, and vegetation is difficult to establish.
- **Too clayey.** - The soil is slippery and sticky when wet and slow to dry.
- **Too sandy.** - Soil is soft and loose, droughty, and low in fertility.
- **Toxicity.** - Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.
- **Unstable fill.** - Risk of caving or sloughing on banks of fill material.

Section-iii-A   Cropland Interpretations

Information in this section can be used to plan the use and management of soils for crops and pasture. Conservation planners and others using this information can evaluate the effect of crop management systems on productivity and on the environment in all or part of the survey area.

The following is filed or referenced in this section:

- Soil Erodibility (K) Factor and Soil-Loss Tolerance (T) Factor Section
  - Soil Erodibility (K) Factor
  - Soil-Loss Tolerance (T) Factor
  - USLE K and T Factors – File – **USLE0xx.xls**, **0xx =** County Fips Code **(not in this dataset)**
- Highly Erodible Land (HEL) Section
  - Water Erosion
  - Wind Erosion
  - HEL Lists in Vermont
  - County Legends – file - **HEL0xx.xls or hel0xx.doc**, **0xx**= county fips code
- Agricultural Value Groups for Vermont Soils, Revised March 1995. (Reference on how ratings were derived. Available in hardcopy only.)
- Agricultural Value Groups for Vermont Soils, Revised March 1995 - Amendment I, August 1999.
- Vermont's Primary Agricultural Soils
  - Prime Farmland List
  - Additional Farmland of Statewide Importance List
  - Additional Farmland of Local Importance List
  - County Legends – file - **agval and prime0xx.xls**, **0xx**= county fips code
- Act 250 Guidance, Criteria 9B – Primary Agricultural Soils, Criteria 9C – Forest and Secondary Agricultural Soils, December 18, 2001
  - List of soils with very limited potential for commercial forestry or agriculture for Criteria 9C
    - County Legends – file - **act250-9c0xx.xls**, **0xx**= county fips code
- Land Capability Classification Section
- Crop Yield Estimates Section

Soil Erodibility (K) Factor and Soil-Loss Tolerance (T) Factor Section

Soil erodibility factors (K) and soil-loss tolerances (T) are used in an equation that predicts the amount of soil loss resulting from rainfall erosion on crop land. The soil loss prediction procedure is useful to guide the selection of practices of soil and water conservation. The procedure is outlined and illustrated in Agricultural Handbook No. 703.

Soil Erodibility (K) Factor

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-Loss Tolerance (T) Factor

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year. Soil-loss tolerances are based on guidelines found in exhibit 618-14 of the National Soil Survey Handbook.

USLE K and T Factors

The Universal Soil Loss Equation (USLE) was used to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

The USLE K and T Factors are maintained for documentation of HEL determinations for the 1990 Farm Bill.

Highly Erodible Land Section

The basis for identifying highly erodible lands is the erodibility index of the soil map unit. The erodibility index of the soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T value represents the maximum annual rate of soil erosion that could take place without causing a decline in long term productivity. A soil map unit with an erodibility index of 8 or more is a highly erodible soil map unit.

Water Erosion

Potential erodibility for sheet and rill erosion is estimated by multiplying the following factors of the Universal Soil Loss Equation (USLE):

1. Rainfall and runoff factor
2. Susceptibility of the soil to water erosion (K).
3. Combined effects of slope length and steepness (LS)

The erodibility index for sheet and rill erosion is represented by the formula RKLS/T. A soil map unit is highly erodible if the LS factor for the shortest length and minimum percent slope is used and the RKLS/T value equals or exceeds 8.

A soil map unit is potentially highly erodible if:

1. The RKLS/T value, using the minimum LS factor, is less than 8, and
2. The RKLS/T value using the maximum LS factor is equal to or greater than 8.

Wind Erosion

Potential erodibility from wind erosion is estimated by multiplying the following factors of the Wind Erosion Equation (WEQ):

1. Climatic characterization of windspeed and surface soil moisture (C)
2. The susceptibility of the soil to wind erosion (I)

The erodibility index for wind erosion is represented by the formula CI/T. A soil map unit is highly erodible if the CI/T value equals or exceeds 8.

HEL Lists in Vermont

In Vermont, Highly Erodible Land lists are for water erosion. Highly eroded areas as a result of wind erosion are extremely rare.

On the Highly Erodible Land list, the following codes are used:

1. Highly Erodible - Soil meets the requirements for Highly Erodible Lands.

2. Potentially Highly Erodible - Range of soil characteristics for the soil as mapped fall within an outside the requirements for Highly Erodible Lands

3. Not Highly Erodible - Soil does not meet the requirements for Highly Erodible Lands.

Agricultural Value Groups for Vermont Soils
Amendment I
August, 1999

In October, 1985, the USDA-Natural Resources Conservation Service published “Agricultural Value Groups for Vermont Soils”. This publication was revised in March, 1995. It compares the “Relative Value” of soils in Vermont for Agriculture and assigned each soil map unit to an Agricultural Value Group.

The information contained in the published document is correct. However, it does not include soils that have been identified in Vermont since 1995. Also it requires the user to determine the Agricultural Value Group of a map unit on a county soil survey legend from a statewide list.

This amendment contains Agricultural Value Groups for all map units used in Vermont, as of August, 1999. The map units are listed by county soil survey legends. The user can evaluate areas of land by matching map unit symbols from a soil map to the appropriate county soil survey legend map unit symbols.

Considerations

This amendment supplements the original publication. It does not replace it. The user should obtain a copy of the original publication to gain an understanding of how the ratings were derived. The assumptions used to derive the Agricultural Value Groups are accurate as of the original publication date, October, 1985.

Agricultural Value Groups for soils map units, not listed in the revised edition, were assigned by comparing the new map units to map units, in the revised edition, with similar agricultural potential. In some cases new map units had slope classes that spanned more then one slope class listed in the revised edition. These new map units were assigned to an Agricultural Value Group based on the slope class that contained their average slope.

Digital Information

The information in this amendment will be available as part of the TOP20 table that is available through the Vermont Center for Geographic Information. The Agricultural Value Groups will be included in a future release of TOP20.

Footnotes

Listed below are the footnotes for the attached legend.

Agricultural Value Groups (Agr Note)

b - The soils in this map unit have a wetness limitation that may be difficult and/or unfeasible to over come. Agricultural Value Groups are based on the assumption that artificial drainage is feasible. Areas of this map unit, where artificial drainage is not feasible should be placed in a lower Agricultural Value Group.

c - Bedrock outcrops are associated with this map unit. Areas of this map unit should be placed in a lower Agricultural Value Group if bedrock outcrops are extensive enough to prohibit efficient farming.

Prime Farmland (Prime Note)

a - If the upper slope class limit of the map unit is between 9 and 15 percent then the areas of the map unit that exceed 8 percent slope don’t qualify as prime farmland. If the upper slope class limit exceeds 15 percent then the areas of the map unit that exceed 15 percent slope don’t qualify as prime farmland.

b - The soils in this map unit have a wetness limitation that may be difficult and/or unfeasible to over come. Areas of this map unit don’t qualify as prime farmland if artificial drainage is not feasible.

c - Bedrock outcrops are associated with this map unit. Areas of this map unit do not qualify as prime farmland.

For More Information

If you have questions about the original publication, Agricultural Value Groups for Vermont Soils, or this amendment, please contact:

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VERMONT'S PRIMARY AGRICULTURAL SOILS November 6, 1996

The soils in Vermont have been classified into four categories with respect to their potential for agriculture. The four categories are Highest, Good, Low and Limited. The soils in the Highest and Good categories will qualify as Primary Agricultural Soils as defined in Act 250. The classification depends on the limitations and capabilities of the soils, the risk of damage when they are used, and the way they respond to management when they are used for common field crops and pasture plants. Soils that qualify for the highest and good categories are listed in the attached table. Definitions of each category and a word of caution follows:

A Word of Caution

This initial placement of soils into Highest and Good Potential is based on the physical and chemical properties of the soils. Size and location of specific areas, accessibility, and current land use were not considered in the ratings.

On-site evaluation is required to determine if wet soils can be adequately drained for crop production. If artificial drainage is not possible or feasible, the soil does not qualify as a primary agricultural soil. Site review also is needed on some floodplain soils to determine frequency of flooding in specific areas.

The soils list is a starting point in the process of determining if a specific area has Primary Agricultural Soils according to Act 250. On-site review is needed to determine if the potential of the soil can be achieved and if it is feasible to use the soil for agriculture. These site reviews should be performed at the time of application.

Some counties and towns have prepared their own list of primary agricultural soils. These lists are patterned after the state list but are personalized for each county and town for planning purposes. Some soils on the state list may be excluded from county lists based on judgment and knowledge of local agricultural leaders. For example, the Raynham soil is considered as primary agricultural soil in Franklin County, but is not in Addison County because areas of Raynham are small and difficult to drain. The variability of a given soil from place to place requires an on-site review when using either a county or state list. Further, the county important farmland maps should not be used with Act 250 applications since they are generalized and not site-specific.

Highest Potential

Soils in this category have high potential for a wide variety of crops adapted to Vermont's climate. High potential soils also qualify for "Prime Farmland" as defined in 7 C.F.R. 657.5 and USDA's Land Use Policy.

Highest potential soils have the best combination of physical and chemical characteristics for producing food, feed, forage, and fiber. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods. In general, these soils have an adequate and dependable water supply from precipitation, a favorable temperature and growing season, acceptable acidity or alkalinity, and few or no surface stones. They are permeable to water and air. They are not excessively erodible do not flood frequently or are protected from flooding.

To qualify for the highest potential category, a soil must meet all the following conditions:

1. The soils have an aquic or udic moisture regime and sufficient available water capacity within a depth of 40 inches, or in the root zone (root zone is the part of the soil that is 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, vegetables, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; and

2. The soils have a temperature regime that is frigid or mesic; and

3. The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches or in the root zone if the root zone is less than 40 inches deep; and

4. 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

5. The soils can be managed so that in all horizons within a depth of 40 inches 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 mmhoc/cm and the exchangeable sodium percentage is less than 15; and

6. The soils are not flooded frequently during the growing season (less often than once in 2 years); and

7. The product of K (erodibility factor) times the percent slope is less than 2.0, and the product of I (soils erodibility) times C (climatic factor) does not exceed 60; and

8. The soils have a permeability rate of at least 0.06 inch per hour in the upper 20 inches, and the mean annual soil temperature at a depth of 20 inches is less than 59 degrees Fahrenheit or higher; and

9. Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches.

Good Potential

Soils in this category have good potential for growing crops, but one or more limitations will restrict the choice of crops and require more intensive management than for soils in the Highest Potential. This category includes those soils that do not qualify as highest potential and have a land capability classification-of Class II, Class III, or Subclass IVw.

The soils in this category have limitations resulting from one or more of the following:

1. Excess slope and an erosion hazard.

2. Excess wetness or slow permeability.

3. A flooding hazard.

4. Shallow depths (less than 20 inches) to bedrock, hardpan, or other layers that limit the rooting zone and available water capacity.

5. Moderately low available water capacity.

For the purposes of administration of the Federal Farmland Protection Policy Act and other federal policies, good potential soils are designated as "Farmlands of Statewide Importance."

Act 250 Guidance
Criteria 9B - Primary Agricultural Soils
Criteria 9C - Forest and secondary agricultural soils.

December 18, 2001

The Natural Resources Conservation Service (NRCS) is listed on the ACT 250 application as a source of information needed for completing criteria 9B, Primary Agricultural Soils and criteria 9C Forest and secondary agricultural soils.

The following is intended as guidance for completing criteria 9B and 9C on ACT 250 applications. This document can be provided to applicants to assist them in determining the number of acres that meet these criteria.

Criteria 9B - Primary Agricultural Soils

The definition of Primary Agricultural Soils can be found in the ACT 250 Vermont's Land Use Development Law, section 601 (15).

"Primary agricultural soils" means soils which have a potential for growing food and forage crops, are sufficiently well drained to allow sowing and harvesting with mechanized equipment, are well supplied with plant nutrients or highly responsive to the use of fertilizer, and have few limitations for cultivation or limitations which may be easily overcome. In order to qualify as primary agricultural soils, the average slope of the land containing such soils does not exceed 15 percent, and such land is of a size capable of supporting or contributing to an economic agricultural operation. If a tract of land includes other than primary agricultural soils, only the primary agricultural soils shall be affected by criteria relating specifically to such soils.

Prime Farmland map units with a rating of Prime or Statewide meet the criteria contained in the definition of Primary Agricultural Soils subject to a determination on whether *such land is of a size capable of supporting or contributing to an economic agricultural operation*.

Determination on whether the size criteria is met is not a determination that NRCS personnel make.

Criteria 9C - Forest and Secondary Agricultural Soils

The definition of Forest and Secondary Agricultural Soils can be found in the ACT 250 Vermont's Land Use and Development Law, section 601 (8).

"Forestry and secondary agricultural soils" means soils which are not primary agricultural soils but which have reasonable potential for commercial forestry or commercial agriculture, and which have not yet been developed. In order to qualify as forest or secondary agricultural soils the land containing such soils shall be characterized by location, natural conditions and ownership patterns capable of supporting or contributing to present or potential commercial forestry or agriculture. If a tract of land includes other than forest or secondary agricultural soil only the forest or secondary agricultural soil shall be affected by criteria relating specifically to such soils.

Reasonable Potential for Commercial Agriculture and Commercial Forestry

Reasonable potential for commercial forestry or commercial agriculture is not defined in ACT 250. Because *reasonable potential* is not defined, no determination of *reasonable potential* of the soil map units is possible in this document.

The definition of forestry and secondary agricultural soils states that *"In order to qualify as forest or secondary agricultural soils the land containing such soils shall be characterized by location, natural conditions, and ownership patterns capable of supporting or contributing to present or potential commercial forestry or agriculture". Location and ownership patterns* are site specific and not related to soil map units. However, *natural conditions* can include soil map unit information related to potential productivity for commercial forestry and commercial agriculture.

Potential Productivity – Commercial Agriculture and Commercial Forestry

Soil map units are compared for their potential for producing and harvesting timber in Forest Value Groups of Vermont (USDA-SCS, Winooski, VT, February, 1991. Soil map units with the following conditions were deemed to have very limited forestry potential: organic soils, soils occurring above 2,500 feet in elevation (cryic soils), miscellaneous land types, very poorly drained soils, and soils exceeding 60 percent in slope. The remaining soil map units have some potential for producing and harvesting timber.

Soil map units are compared for their agricultural potential productivity in Agricultural Value Groups for Vermont (USDA-SCS, Winooski, VT, 1985). Soils map units with the following conditions were considered to have very limited agricultural potential: soils with an extremely stony, very bouldery, or extremely bouldery surface, organic soils, very shallow (less than 10 inches to bedrock) soils, soils on slopes greater than 25 percent, soils with a cryic temperature regime (above 2,500-3,000 feet in elevation), and miscellaneous land types. The remaining soil map units have some potential for crop production.

Because *reasonable potential* is not defined, no further subdivision of the soil map units of their potential for either commercial agriculture or commercial forestry is possible in this document.

Attached to this report is a list of soil map units that have very limited potential for **both** commercial forestry and commercial agriculture. Commercial agriculture includes cultivated crops commonly grown in Vermont, hay, and pasture.

Those soil map units that do not have a prime farmland rating of Prime or Statewide and do not have a very limited potential for **both** commercial forestry and commercial agriculture, as defined in this report, meet the intent of *natural conditions* defined in *Forest or Secondary Agricultural Soils*.

No determination is possible on whether the soil map units on this list have *reasonable potential* for other specialized forest uses, such as sugar bushes or Christmas trees, or for crops not commonly grown in Vermont.

Summary

1. NRCS personnel can provide assistance to customers in determining whether soils meet Criteria 9B and meet *natural conditions capable of supporting or contributing to present or potential commercial forestry or agriculture* as defined in Criteria 9C.

2. Soil map units with a prime farmland rating of Prime or Statewide will meet the definition of Criteria 9B, Primary Agricultural Soils subject to a determination on size of the soil map unit.

3. Soil map units listed in the attachment to this report have very limited potential for commercial forestry and commercial agriculture.

4. No determination is made on whether the soil map units in this attachment have reasonable potential for other specialized forest uses or for crops not commonly grown in Vermont.

5. Those soil map units that do not have a prime farmland rating of Prime or Statewide and do not have a very limited potential for **both** commercial forestry and commercial agriculture, as defined in this report, meet the intent of *natural conditions* defined in Criteria 9C, *Forest or Secondary Agricultural Soils*.

Land Capability Classification Section

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels, capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 and IIIe-6

Crop Yields Section

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the soil survey. In any given year, yields may be higher or lower than those indicated in the table in the soil survey because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the soil survey are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Section II-iii-B   Range Land, Grazed Forest Land, Native Pasture Land Interpretations

Range land is commonly used in the western states. No range land interpretations are not given for soil map units in Vermont.

Pasture land interpretations are found in section II-iii-G.

Section-II-iii-C Forest Land Interpretations

The following is filed or referenced in this

- Woodland Management Section:
  - Erosion Hazard
  - Equipment Limitations
  - Seedling Mortality
  - Windthrow Hazard
  - Plant Competition

- Potential Productivity Section
- Forest Land Value Groups for Vermont Soils, Amendment I, August, 1999
  - County Forest Land Value Groups – File – **forestval0XX.xls**, **0XX**= County Fips Code

Woodland Management Section

Information in this section can be used to plan the use and management of soils for woodlands. Conservation planners and others using this information can evaluate the effect of management concerns on managing woodlands.

Erosion Hazard

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope.

- A rating of slight indicates that no particular prevention measures are needed under ordinary conditions.
- A rating of moderate indicates that erosion-control measures are needed in certain silvicultural activities.
- A rating of severe indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment Limitations

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer.

- A rating of slight indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month.
- A rating of moderate indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months.
- A rating of severe indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling Mortality

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect.

- A rating of slight indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent.
- A rating of moderate indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent.
- A rating of severe indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow Hazard

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers.

- A rating of slight indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them.
- A rating of moderate indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong.
- A rating of severe indicates that many trees can be blown down during these periods.

Plant Competition

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity.

- A rating of slight indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition.
- A rating of moderate indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands.
- A rating of severe indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

Potential Productivity Section

Woodland productivity tables in the soil survey can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the ordination symbol, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce in a pure stand under natural conditions. The number 1 indicates low potential productivity; 2 or 3, moderate; 4 or 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter R indicates steep slopes; X, stoniness or rockiness; W, excess water in or on the soil; T, toxic substances in the soil; D, restricted rooting depth; C, clay in the upper part of the soil; S, sandy texture; F, a high content of rock fragments in the soil; L, low strength; and N, snowpack. The letter A indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, L, and N.

The potential productivity of merchantable or common trees on a soil is expressed as a site index and as a volume number. The site index is the average height, in feet, that dominant and co-dominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The volume, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under common trees for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

The species that is followed by an asterisk under common trees is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Forest Land Value Groups for Vermont Soils
Amendment 1
August, 1999

On February 25, 1991, the USDA Natural Resources Conservation Service in cooperation with the Vermont Department of Forest and Parks published “Soil Potential Study and Forest Land Value Groups for Vermont Soils”. This document compares soils in Vermont for their “Relative Value” as forest land and assigned each soil to a Forest Land Value Group.

The information contained in the published document is correct. However, it does not include soils that have been identified in Vermont since 1991. Also, it requires the user to determine the Forest Land Value Group of a map unit from a statewide list of soils.

This amendment contains Forest Land Value Groups for all soil map units used in Vermont as of August, 1999. The map units are listed by county soil survey legends. The user can evaluate areas of forest land by matching map unit symbols from a soil map to the appropriate county soil survey legend.

Considerations

This amendment supplements the original publication. It does not replace it. The user should obtain a copy of the original publication to gain an understanding of how the ratings were derived.

The assumptions used to derive the Forest Land Value Groups are accurate as of the original publication date February 25, 1991.

Digital Information

The information in this amendment will be available as part of the TOP20 table that is available through the Vermont Center for Geographic Information. The Forest Land Value Groups will be included in a future release of TOP20.

For More Information

If you have questions about the original publication, Soil Potential Study and Forest Land Value Groups for Vermont Soils, or this amendment, please contact:

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Section-II-iii-D   Nonagricultural Interpretations

The purpose of these interpretative ratings is to help engineers, planners, and others understand how soil properties influence behavior when used for nonagricultural uses such as building site development or construction materials.

The following is filed or referenced in this section:

- Building Site Development Section
    - Shallow Excavations
    - Dwellings and Small Commercial Buildings
    - Local Roads and Streets
    - Lawns and Landscaping

- Construction Materials Section
    - Roadfill
    - Sand or Gravel
    - Topsoil

Building Site Development Section

Soil surveys show the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered:

1. **slight** if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome;

2. **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and

3. **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and Small Commercial Buildings

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local Roads and Streets

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and Landscaping

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Construction Materials Section

This section gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated **good, fair,** or **poor** as a source of roadfill and topsoil. They are rated as a **probable** or **improbable** source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill

Roadfill is soil material that is excavated in one place and used in road embankments in another place. Soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table in the soil survey showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Sand or Gravel

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a **probable** source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an **improbable** source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

In some tables, soils are rated **good, fair** or **poor**. Soils rated **good** contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated **fair** have more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated **poor** have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Topsoil

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated **good** have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated **fair** are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated **poor** are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Section II-iii-E Recreational Interpretations

The following is referenced or filed in this section:

- Camp Areas
- Picnic Areas
- Play Grounds
- Paths and Trails
- Golf Fairways

The soils are rated according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate, or severe.

- **Slight** means that soil properties are generally favorable and that limitations are minor and easily overcome.
- **Moderate** means that limitations can be overcome or alleviated by planning, design, or special maintenance.
- **Severe** means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

This information can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields and interpretations for dwellings without basements and for local roads and streets.

Camp Areas

Camp areas require site preparation, such as shaping and leveling the tent 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. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic Areas

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and Trails

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf Fairways

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Section II-iii-F   Wildlife Interpretations

The following is filed or referenced in this section:

- Wildlife Habitat Section
  - Grain and Seed Crops
  - Grasses and Legumes
  - Wild Herbaceous Plants
  - Hardwood Trees and Woody Understory
  - Wetland Plants
  - Shallow Water
  - Openland Wildlife
  - Woodland Wildlife
  - Wetland Wildlife

Wildlife Habitat Section

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

The soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor.

- A rating of **good** indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected.
- A rating of **fair** indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results.
- A rating of **poor** indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive.
- A rating of **very poor** indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and Seed Crops

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and Legumes

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild Herbaceous Plants

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, wheatgrass, and grama.

Hardwood Trees and Woody Understory

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountain mahogany, bitterbrush, snowberry, and big sagebrush.

Wetland Plants

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow Water

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

Openland Wildlife

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Woodland Wildlife

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Wetland Wildlife

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Section II-iii-G   Pastureland and Hayland Interpretations

This section provides information concerning the suitability of soils for the production of pasture and hay.

Yield Estimates

The average yields per acre that can be expected of the principle pasture or hayland crops, under a high level of management, are presented in this section. In any given year, yields may be higher or lower because of variations in rainfall or other climatic factors. The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

Under good management, proper grazing is essential for the production of high quality forage, stand survival, and erosion control. Proper grazing helps plants maintain sufficient and generally vigorous top growth during the growing season. Brush control is essential in many areas, and weed control generally is needed. Rotational grazing and renovation are also important management practices.

Yield estimates are often provided in animal unit months (AUM) or the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

Section II-iii-H Mined Land Interpretations

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 they provide a favorable medium for plant growth.

Most new state mined land programs emphasize that the land surface be restored to about its natural configuration or better and the soil be reconstructed to maintain or improve its suitability for its intended use. Knowledge of the soil and underlying material is needed to plan proper reconstruction operations of mined land. It may be necessary to rate the topsoil, subsoil, and substratum separately to determine the suitability of each segment for the reconstruction. If they all rate **good**, there may be little justification for keeping them separate for soil reconstruction. If the topsoil is rated better than the subsoil or substratum, then it should generally be kept separate, depending on its thickness and the anticipated use of the land.

When soil materials are properly used in reconstruction, a rating of **good** means vegetation is relatively easy to establish and maintain, the surface is stable and resists erosion, and 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 application 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.

Refer to Technical Guide Reference CPA #10, "Re-vegetating Sand and Gravel Burrow Pits in the Northeast," and the publication, "Re-vegetating Sand and Gravel Pits in Vermont."

Section II-iii-I   Windbreak Interpretations

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Windbreak tables show the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in the table are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Natural Resources Conservation Service or of the Cooperative Extension Service or from a commercial nursery.

Section II-iii-J   Engineering Interpretations

The following is filed or referenced in this section:

- Engineering Index Properties Section
- Physical and Chemical Analyses of Selected Soils Section
- Soil and Water Features Section
- Water Management Section
    - Pond Reservoir Areas
    - Embankments, Dikes, and Levees
    - Aquifer-Fed Excavated Ponds
    - Drainage
    - Irrigation
    - Terraces and Diversions
    - Grassed Waterways

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Engineering Index Properties Section

Estimates of the engineering classification and of the range of index properties are given for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series in section II-ii-B.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system and the system adopted by the American Association of State Highway and Transportation Officials.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted.

Physical and Chemical Analyses of Selected Soils Section

The results of physical and chemical analysis of several typical pedons in the survey area are given in soil surveys. The data are for soils sampled at carefully selected sites. Unless otherwise indicated, the pedons are typical of the series. They are described in the section II-ii-B.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows.

- Coarse materials (2-75 mm fraction) weight estimates of the percentages of all material less than 75 mm.
  Coarse materials (2-250 mm fraction) volume estimates of the percentages of all material greater than 2 mm (3B2).
- Sand (0.05-2.0 mm fraction) weight percentages of material less than 2 mm.
- Silt (0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm.
- Clay (fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm.
- Carbonate clay (fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm.
- Water retained pressure extraction, percentage of ovendry weight of less than 2 mm material; 1/3 or 1/10 bar, 15 bars.
- Water-retention difference between 1/3 bar and 15 bars for whole soil.
- Water-retention difference between 1/10 bar and 15 bars for whole soil.
- Bulk density of less than 2 mm material, saran-coated clods field moist, 1/3 bar (4A1d), ovendry (4A1h).
- Moist bulk density of less than 2 mm material, cores (4A3).
- Moist bulk density of less than 2 mm material, compliant cavity (4A5).
- Linear extensibility change in clod dimension based on whole soil (4D).
- Organic carbon wet combustion. Walkley-Black modified acid-dichromate, ferric sulfate titration (6A1c).
- Organic carbon dry combustion (6A2d).
- Total nitrogen Kjeldahl (6B3).
- Extractable cations ammonium acetate pH 7.0, atomic absorption; calcium (6N2e), magnesium (6O2d), sodium (6P2b), potassium (6Q2b).
- Extractable cations ammonium acetate pH 7.0, EDTA-alcohol separation; calcium (6N2a), magnesium (6O2a); flame photometry; sodium (6P2a), potassium (6Q2a).
- Extractable acidity barium chloride-triethanolamine IV (6H5a).
- Cation-exchange capacity ammonium acetate, pH 7.0, steam distillation (5A8b).
- Cation-exchange capacity sum of cations (5A3a).
- Effective cation-exchange capacity sum of extractable cations plus aluminum (5A3b).
- Base saturation ammonium acetate, pH 7.0 (5C1).
- Base saturation sum of cations, TEA, pH 8.2 (5C3).
- Reaction (pH) 1:1 water dilution (8C1f).
- Reaction (pH) saturated paste (8C1b).
- Reaction (pH) potassium chloride (8C1g).
- Reaction (pH) sodium fluoride (8C1d).
- Reaction (pH) calcium chloride (8C1f).
- Aluminum potassium chloride extraction (6G9).
- Aluminum acid oxalate extraction (6G12).
- Iron acid oxalate extraction (6C9a).
- Silica acid oxalate extraction (6V2).
- Sesquioxides dithionate-citrate extract; iron (6C2b), aluminum (6G7a), manganese (6D2a).
- Soil resistivity saturated paste (8E1).
- Total soluble salts estimate from resistivity (8A2).

- Total soluble salts estimate from conductivity (8D5).
- Carbonate as calcium carbonate (fraction less than 2 mm) manometric (6E1g).
- Carbonate as calcium carbonate (fraction less than 20 mm) manometric (6E4).
- Gypsum precipitation in acetone (6F1a).
- Soluble ions acid titration, saturated paste; carbonate (6I1b), bicarbonate (6J1b).
- Soluble ions anion chromatograph, saturated paste; chloride (6K1c), sulfate (6L1c), nitrate (6M1c).
- Electrical conductivity saturation extract (8A3a).
- Sodium adsorption ratio (5E).
- Extractable phosphorus Bray P-1 (6S3).
- Available phosphorus (method of reporting laboratory).

Soil and Water Features Section

Soil survey give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

The table in the soil survey gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); occasional that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and frequent that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Common is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, long if 7 days to 1 month, and very long if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. In the table in the soil survey are the depth to the seasonal high water table; the kind of water table (perched, apparent, or artesian); and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in the table in the soil survey.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. An artesian water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table in the soil survey shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as low, moderate, or high, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as low, moderate, or high. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Water Management Section

Soil surveys give information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds.

The limitations are considered:

- **slight** if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome;
- **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations;
- **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table in the soil survey also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond Reservoir Areas

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, Dikes, and Levees

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-Fed Excavated Ponds

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and Diversions

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed Waterways

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Section II-iii-K   Waste Disposal Interpretations

The following is filed or referenced in this section:

- Sanitary Facilities Section
  - Daily Cover for Landfill
  - Septic Tank Absorption Fields
  - Sewage Lagoons
  - Sanitary Landfills

- Ancillary Soil Interpretation Ratings for On-site Sewage Disposal in Vermont, January 1997
  - County ratings list – file – **onsite septic0XX.xls**, **0XX** = county fips code

- Agricultural Waste Management

Sanitary Facilities Section

Soil surveys shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered

- **slight** if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome;
- **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations;
- **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Daily Cover for Landfill

Suitability of the soils for use as daily cover for landfill is rated. A rating of good indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; fair indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and poor indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Ratings are given for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary Landfills

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill are trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

ANCILLARY SOIL INTERPRETATION RATINGS
FOR
ON-SITE SEWAGE DISPOSAL IN VERMONT

Natural Resources Conservation Service
Winooski, Vermont
January, 1997

FOREWORD

* The purpose of this report is to provide information on the soils in Vermont in relation to their use for as sites for small-scale wastewater disposal systems.

* It is intended for planning purposes only.

* It does not supersede the need for an on-site soil investigation and analysis of other site factors that can affect the placement of a septic system.

* The "ASSUMPTIONS AND LIMITATIONS OF THIS REPORT" should be clearly understood before the ratings are utilized.

* Questions concerning this report should be directed to the:
Natural Resources Conservation Service Soils Staff
356 Mountain View Drive, Suite 105
Colchester, Vermont, 05446.
1-802-951-6795, ext. 236.

* The ratings are available in digital format from the:
Vermont Center For Geographic Information (VCGI)
206 Morrill Hall
University Of Vermont
Burlington, Vermont 05405
1-802-656-4277

NOTE TO THE USER ABOUT REVISIONS TO PREVIOUS EDITIONS

This report replaces editions issued in July, 1994 and January, 1996. It reflects changes in the Vermont Environmental Protection Rules, August 8, 1996 which succeeded and superseded Environmental Protection Regulations, September 10, 1982, and Vermont Health Regulations, Chapter 5, Sanitary Engineering, Subchapter 10, Part II (see sec. 1-101, Appendix 1-1A Env. Prot. Rules, 1996).

The only rule change that effected these ratings was increasing the maximum slope allowable for construction of a mound system from 12 to 20 percent (see sec. 1-714, E,4,c Env. Prot. Rules, 1996). This resulted in the footnote c being dropped from some map units in classes 3, 4, and 5. In addition some map units that were previously in class 6 are now in classes 3,4, or 5 with a c footnote. The footnote c was amended to reflect the change in slope.

There are other changes to the rules including allowing at-grade systems and the use of intermittent or re-circulating sand filters under certain conditions. In this report at-grade systems may be an alternative to a mound system for map units in class 3 under certain conditions. Sand filters may be appropriate for systems installed on map units in class 4 or class 5.

In previous editions map units with little or no identifiable soil material were not assigned to a class and identified with a rating of 0. In this report these map units are assigned to "Class 7 Not Rated".

Obtain hard copy of county ratings lists from the District Conservationist if not filed in this section of the FOTG.

INTRODUCTION

The Natural Resources Conservation Service (NRCS) has primary responsibility for classifying and mapping the soils in Vermont. Along with the soil maps, general information on the behavior of map units for various uses is provided by NRCS. Map units are rated as having slight, moderate or severe limitations for each use. The criteria for these ratings is based on national standards (USDA-NRCS, 1993). These interpretations have been accepted by users and provide a uniform, nationwide system of rating soils.

Unfortunately, these ratings have a few shortcomings in Vermont. One problem is that an extremely high percentage of map units in Vermont are rated "severe" for septic tank absorption fields. The degree of severity is not described, which makes it difficult to compare the relative limitations of different types of soils that are rated "severe." The ratings also do not relate in any direct way to the regulations that the State of Vermont has in place to guide the siting of individual on-site septic disposal systems.

In this report, the soil properties that affect septic system design have been integrated with current design requirements set forth by State of Vermont Environmental Protection Rules (1996) into a set of ancillary soil interpretations for septic system suitability. **The map units in Vermont have been separated into seven different classes based on the type of septic system that would normally be installed on that map unit**. The classes are based on the "septic groups" established in the Soil Potential report for Chittenden County, Vermont (NRCS, 1986), although the groups have been somewhat revised.

ASSUMPTIONS AND LIMITATIONS OF THIS REPORT

1. This report is intended for general planning purposes only and is not, in any way, intended to replace or supersede an on-site soil investigation.

2. Onsite soil investigations for siting of septic systems are required by the Environmental Protection Rules (see sec. 1-707, Env. Prot. Rules, 1996).

3. The ratings in this report are based on the installation of a new septic system for a new single-family home and do not apply to the siting of a replacement system for an existing residence.

4. The ratings reflect state regulations as presently written and enforced in August, 1996.

5. Updated regulations may have an effect on the placement of map units within the different classes.

6. The classes in this report were generated using soil characteristic data stored in the NRCS state soil survey database, in December 1995. Updates to the database may have an effect on the placement of map units within the different classes.

7. This report does not consider other site factors, such as wellhead and source protection areas, isolation distances and the size of the parcel, that can affect placement and design of septic systems.

8. The septic system classes used in this report apply only to the State of Vermont.

HOW THE RATINGS WERE DERIVED

The ratings were derived from soil properties, extracted from the soil attribute tables of the state soil survey database. The following soil properties were used: slope, seasonal high water table depth and kind, depth to bedrock, annual flooding frequency and permeability of the substratum.

The map units were divided into the following groups, with similar interpretive soil properties:

A. This group consists of map units that have a depth to seasonal high water table of greater than 6 feet. Depth to bedrock is greater than 60 inches. Permeability of the substratum is rapid to very rapid. The map units in this group are not subject to flooding.

B. This group consists of map units that have a depth to seasonal high water table of greater than 6 feet. Depth to bedrock is greater than 60 inches. Permeability of the substratum is moderate to moderately rapid. The map units in this group are not subject to flooding.

C. This group consists map units that are normally made up of two or more soils. Depth to seasonal high water table is greater than 6 feet. Depth to bedrock ranges from 20 to more than 60 inches, with the shallowest soil normally having bedrock at 20 to 40 inches. Permeability of the substratum is moderate to rapid. The map units in this group are not subject to flooding.

D. This group consists of map units that have a depth to seasonal high water table that ranges from 2 to more than 6 feet. Depth to bedrock is greater than 60 inches. Permeability of the substratum is moderately slow to very slow. The map units in this group are not subject to flooding.

E. This group consists of map units that have a depth to seasonal high water table that ranges from 6 to more than 18 inches, if the water table is perched or from 6 to more than 24 inches, if the water table is apparent. Depth to bedrock is more than 60 inches. The map units in this group are not subject to flooding.

F. This group consists of map units that are normally made up of two or more soils. At least one soil in the map unit has a depth to seasonal high water table that ranges from 6 to more than 18 inches if the water table is perched or from 6 to more than 24 inches if the water table is apparent. Most map units have at least one soil that has a seasonal high water table that is greater than 6 feet. Depth to bedrock ranges from 20 to more than 60 inches, with the shallowest soil normally having bedrock at 20 to 40 inches. The map units in this group are not subject to flooding.

G. This group consists of map units made up of one or more soils. Depth to a seasonal high water table is more than 6 feet. Depth to bedrock ranges from 10 to more than 60 inches, with the shallowest soil always having bedrock at less than 20 inches. The map units in this group are not subject to flooding.

H. This group consists of map units that are subject to flooding or have a depth to seasonal high water table ranging from 0 to 18 inches. The seasonal high water table is within 6 inches of the surface for part of the year. It also includes map units made up of two or more soils with at least one soil, that makes up more than 40 percent of the map unit, having bedrock at less than 10 inches.

I. This group consists of map units with little or no identifiable soil material.

The soil groups were then subdivided into rating classes based on the slope of the map unit; see "RATING CLASS CRITERIA". The slope breaks used to subdivide the soil groups were defined by the following criteria based on state regulation:

1. Normally a conventional system can't be installed in an area with a ground slope that exceeds 20 percent (see sec. 1-708,A,1,e, Env. Prot. Rules, 1996).

2. Site modification is allowed in some areas with excessive slope (see sec. 1-714,D,1, Env. Prot. Rules, 1996).

3. A mound system can't be installed in an area with a ground slope greater than 20 percent (see sec. 1-714,E,4,c, Env. Prot. Rules, 1996).

In addition to the seven classes, footnotes are used to describe the conditions more specifically on certain map units, see "FOOTNOTES".

ANCILLARY SEPTIC SYSTEM RATINGS CLASSES

The seven interpretive separations, or classes, are defined below.

Class 1 Conventional/Soil Replacement. This class is composed of coarse textured, sandy and gravelly glacial outwash map units. Normally, conventional septic systems can be installed on these sites (see sec. 1-708, Env. Prot. Rules, 1996). Backfilling with finer textured material in the area of the absorption field is often required to slow the percolation rate enough to allow for thorough filtering of effluent (see sec. 1-714,F., Env. Prot. Rules, 1996). This process is commonly referred to as "soil replacement."

Class 2 Conventional. This class is composed of well drained glacial till or lacustrine map units with a loamy, friable substratum. Normally, conventional septic systems can be installed on these sites (see sec. 1-708, Env. Prot. Rules, 1996).

Class 3 Mound. This class is composed of soils that are limited by depth to seasonal high water table, depth to bedrock, or permeability of the substratum. These sites typically require mound systems (see sec. 1-714, E., Env. Prot. Rules, 1996) . An at-grade system may be used on sites with a maximum slope of 12% if other site requirements are met (see sec. 1-714, G., Env. Prot. Rules, 1996).

Class 4 Test, Mound, Curtain Drain. This class is composed of map units that usually require on-site monitoring in order to establish their suitability for septic system absorption fields. A significant percentage of these map units are typically found unsuitable for septic tank absorption fields due to the depth of the high water table. Once a site is determined to be acceptable, mound systems are normally specified (see sec. 1-714,E., Env. Prot. Rules, 1996). Under certain conditions, curtain drains may be used to lower the water table to a depth suitable to meet State requirements (see sec. 1-714, C., Env. Prot. Rules, 1996).

Class 5 Marginally Suitable. This class is composed of map units that are generally unsuitable for septic tank absorption fields because of depth to bedrock or slope. In general, areas of these map units may be suitable for a mound system where the depth to bedrock ranges from 2 to 6 feet and the slope is less than 20 percent. They may be suitable for a conventional system where the depth to bedrock is greater than 6 feet and the slope is less than 20 percent.

Class 6 Not Suited. This class is composed of map units that are generally too rocky, too shallow, too wet, too steep, subject to flooding or otherwise unsuitable for use as septic tank absorption fields.

Class 7 Not Rated. Some map units have not been rated. These map units have little or no identifiable soil material. These areas include gravel and sand pits, urban land, quarries, and other areas where the native soil material has been excavated, re-graded, filled, or covered over by urban structures. Onsite investigations are needed to determine the suitability of these map units for septic systems.

OPTIONAL THREE CLASS SYSTEM

An alternative grouping for broad planning can be made using the following classes.

Conventional Systems or Good. Comprised of Classes 1 and 2.

Mound Systems or Fair. Comprised of Classes 3 and 4.

Unsuitable or Poor. Comprised of Classes 5, 6, and 7.

FOOTNOTES

There is an imperfect fit between the range in characteristics of NRCS map units and the State of Vermont septic system criteria. The following three footnotes describe situations where there is an overlap between map unit ranges and the State regulations. The footnotes amend the class rating in the tables for the map units affected.

a. Some areas within this unit are less than 24 inches to bedrock and are not suitable for a septic system. However, there are other areas that are deeper and may be acceptable for a septic system.

b. This map unit has a slope limitation. However, there may be areas within this unit that are flat enough to place a septic system, or cut and fill site modifications may produce a suitable area within the unit.

c. Some areas within this map unit are less than 20% slope and are suitable for a mound system. However, other areas within this map unit exceed 20% slope and are not suitable for a mound system.

REFERENCES

1. Soil Survey Staff, Soil Conservation Service, National Soils Handbook, title 430-VI (Washington D.C., U.S. Government Printing Office, November, 1993).

2. Soil Potential for Septic Tank Absorption Fields in Chittenden County, Vermont, USDA Soil Conservation Service, Essex Junction, VT, April, 1986.

3. Environmental Protection Rules (Chapter 1), Department of Environmental Conservation, Agency of Natural Resources, State of Vermont, August 8, 1996.

Agricultural Waste Management Section

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

The degree and kind of soil limitations affecting the treatment of agricultural waste, including municipal and food-processing wastewater and effluent from lagoons or storage ponds are shown in Agricultural waste management tables. Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. In the context of these tables, the effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings in the tables are for waste management systems that not only dispose of and treat organic waste or wastewater but also are beneficial to crops (application of manure and food-processing waste, application of sewage sludge, and disposal of wastewater by irrigation) and for waste management systems that are designed only for the purpose of wastewater disposal and treatment (overland flow of wastewater, rapid infiltration of wastewater, and slow rate treatment of wastewater).

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. Not limited indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. Slightly limited indicates that the soil has features that are generally favorable for the specified use. The limitations are minor and can be easily overcome. Good performance and low maintenance can be expected. Somewhat limited indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. Very limited indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Application of manure and food-processing waste not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. Manure is the excrement of livestock and poultry, and food-processing waste is damaged fruit and vegetables and the peelings, stems, leaves, pits, and soil particles removed in food preparation. The manure and food-processing waste are either solid, slurry, or liquid. Their nitrogen content varies. A high content of nitrogen limits the application rate. Toxic or otherwise dangerous wastes, such as those mixed with the lye used in food processing, are not considered in the ratings.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the waste is applied, and the method by which the waste is applied. The properties that affect absorption include permeability, depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, and available water capacity. The properties that affect plant growth and microbial activity include reaction, the sodium adsorption ratio, salinity, and bulk density. The wind erodibility group, the soil erodibility factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

Application of sewage sludge not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. Sewage sludge is the residual product of the treatment of municipal sewage. The solid component consists mainly of cell mass, primarily bacteria cells that developed during secondary treatment and have incorporated soluble organics into their own bodies. The sludge has small amounts of sand, silt, and other solid debris. The content of nitrogen varies. Some sludge has constituents that are toxic to plants or hazardous to the food chain, such as heavy metals and exotic organic compounds, and should be analyzed chemically prior to use.

The content of water in the sludge ranges from about 98 percent to less than 40 percent. The sludge is considered liquid if it is more than about 90 percent water, slurry if it is about 50 to 90 percent water, and solid if it is less than about 50 percent water.

Ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, the rate at which the sludge is applied, and the method by which the sludge is applied. The properties that affect absorption, plant growth, and microbial activity include permeability, depth to a water table, ponding, the sodium adsorption ratio, depth to bedrock or a cemented pan, available water capacity, reaction, salinity, and bulk density. The wind erodibility group, the soil erodibility factor K, and slope are considered in estimating the likelihood that wind erosion or water erosion will transport the waste material from the application site. Stones, cobbles, a water table, ponding, and flooding can hinder the application of sludge. Permanently frozen soils are unsuitable for waste treatment.

Disposal of wastewater by irrigation not only disposes of municipal wastewater and wastewater from food-processing plants, lagoons, and storage ponds but also can improve crop production by increasing the amount of water available to crops. The ratings are based on the soil properties that affect the design, construction, management, and performance of the irrigation system. The properties that affect design and management include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, permeability, slope, and flooding. The properties that affect construction include stones, cobbles, depth to bedrock or a cemented pan, depth to a water table, and ponding. The properties that affect performance include depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, reaction, and the cation-exchange capacity, which is used to estimate the capacity of a soil to adsorb heavy metals. Permanently frozen soils are not suitable for disposal of wastewater by irrigation.

Overland flow of wastewater is a process in which wastewater is applied to the upper reaches of sloped land and allowed to flow across vegetated surfaces, sometimes called terraces, to runoff-collection ditches. The length of the run generally is 150 to 300 feet. The application rate ranges from 2.5 to 16.0 inches per week. It commonly exceeds the rate needed for irrigation of cropland. The wastewater leaves solids and nutrients on the vegetated surfaces as it flows downslope in a thin film. Most of the water reaches the collection ditch, some is lost through evapotranspiration, and a small amount may percolate to the ground water.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, and the design and construction of the system. Reaction and the cation-exchange capacity affect absorption. Reaction, salinity, and the sodium adsorption ratio affect plant growth and microbial activity. Slope, permeability, depth to a water table, ponding, flooding, depth to bedrock or a cemented pan, stones, and cobbles affect design and construction. Permanently frozen soils are unsuitable for waste treatment.

Rapid infiltration of wastewater is a process in which wastewater applied in a level basin at a rate of 4 to 120 inches per week percolates through the soil. The wastewater may eventually reach the ground water. The application rate commonly exceeds the rate needed for irrigation of cropland. Vegetation is not a necessary part of the treatment; hence, the basins may or may not be vegetated. The thickness of the soil material needed for proper treatment of the wastewater is more than 72 inches. As a result, geologic and hydrologic investigation is needed to ensure proper design and performance and to determine the risk of ground-water pollution.

The ratings are based on the soil properties that affect the risk of pollution and the design, construction, and performance of the system. Depth to a water table, ponding, flooding, and depth to bedrock or a cemented pan affect the risk of pollution and the design and construction of the system. Slope, stones, and cobbles also affect design and construction. Permeability and reaction affect performance. Permanently frozen soils are unsuitable for waste treatment.

Slow rate treatment of wastewater is a process in which wastewater is applied to land at a rate normally between 0.5 inch and 4.0 inches per week. The application rate commonly exceeds the rate needed for irrigation of cropland. The applied wastewater is treated as it moves through the soil. Much of the treated water may percolate to the ground water, and some enters the atmosphere through evapotranspiration. The applied water generally is not allowed to run off the surface. Waterlogging is prevented either through control of the application rate or through the use of tile drains, or both.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, and the application of waste. The properties that affect absorption include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, permeability, depth to bedrock or a cemented pan, reaction, the cation-exchange capacity, and slope. Reaction, the sodium adsorption ratio, salinity, and bulk density affect plant growth and microbial activity. The wind erodibility group, the soil erodibility factor K, and slope are considered in estimating the likelihood of wind erosion or water erosion. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

Section II-iii-L Water Quality and Quantity Interpretations

FSA-CRP Leaching Index

This report produces Leaching Index Values (1, 2, and 3) suitable for use as described in Part 539.58 - National Ranking Factor N2, Subfactor B in the CRP Manual.

The values 1, 2, and 3 are derived by using the same algorithm included in the State Soil Survey Database (SSSD) RV Generator to produce values 1, 2, 3, and 4, but this report reverses the order of meaning and combines values 3 and 4. Thus, this report correctly reports 1 as Low, 2 as Medium, and 3 as High. These values are ready for use in determining signup scores for National ranking subfactor N2 without further code conversion.

The following is filed or referenced in this section:

- Leaching Index. File - **leach0xx.xls.** 0xx = county FIPS code.

Soil Rating for Nitrate and Soluble Nutrients Section

This section provides a way to determine the degree to which water percolates below the root zone in certain soils. Percolating water containing dissolved nutrients could be a hazard to ground water. The method is based on a Leaching Index (LI).

For areas with ground water concerns, the LI should be determined to evaluate the potential for contaminating the ground water with soluble nutrients. The LI uses annual precipitation, hydrologic soil group, and rainfall distribution data.

Nitrate Leaching Index Maps

A LI map for each hydrologic soil group and weather station data is filed in Section I-iii, Maps. The hydrologic soil group describes those soils that do not have dual hydrologic ratings because of differences in drainage. If the soil has a high LI and is over a shallow aquifer, soluble nutrients (especially nitrates) may contaminate the groundwater.

The LI does not account for irrigation. If irrigation is applied only to supply needs, there will be little additional loss below the root zone. The additional loss would be relative to the precipitation events after the soil profile is saturated or nearly saturated due to irrigation.

In areas of marginal water quality, the amount of irrigation water applied includes a leaching fraction to insure that salts do not build in the soil. If a leaching fraction is applied this amount of water must be added to the LI.

Procedure

Follow these steps to determine the leaching index of a certain soil:

1. Determine the soil's hydrologic group.

2. Find the Leaching Index (LI) from the Leaching Index Maps in Section I-iii, Maps.

3. Interpret leaching potentials.

Guidelines for Using LI

1. A LI below 2 inches indicates that the potential for soluble nutrient leaching below the root zone is low. Apply nitrogen in accordance with recommendations.

2. A LI between 2 and 10 inches indicates that the potential for soluble nutrient leaching below the root zone is intermediate. Additional site evaluations are in order. Practices specified under "LI greater that 10 inches" should be considered.

3. A LI greater than 10 inches indicates that the potential for soluble nutrient leaching below the root zone is large. The following practices shall be implemented as applicable to reduce the potential for nitrate leaching to groundwater.
   - Strict timing of application of nitrogen in accordance with recommendations of UVM
   - Use of management practices such as cover crops to take up excess nutrients and prevent their movement out of the root zone
   - Avoid nitrate leaching from excessive irrigation scheduling practices

Section II-iii-M Hydric Soil Interpretations

In this section, hydric soils are defined and described and the hydric soils in the survey area are listed. The following is referenced or filed in this section:

- County Hydric Soils List – file **– hydric list0XX.doc** – **0XX** represents the county fips code
- Hydric Soils of the United States
- Hydric Soil Technical Note VT-1, Depleted Matrix and Gleyed Matrix, December 18, 2001

The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (1, 2, 5, 6). Criteria for each of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (3). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or non-hydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria which identify those estimated soil properties unique to hydric soils have been established (4). These criteria are used to identify a phase of a soil series that normally is associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (7, 9) and in the "Soil Survey Manual" (8).

If soils are wet enough for a long enough period to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators that can be used to make onsite determinations of hydric soils in this survey area are specified in "Field Indicators of Hydric Soils in the United States"(10).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater is determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described as deep as necessary for an understanding of the redoximorphic processes. Then, using the completed soil descriptions, soil scientists can compare the soil features required by each indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if one (or more) of the approved indicators is present.

This survey can be used to locate probable areas of hydric soils.

Map units that are made up of hydric soils may have small areas, or inclusions, of non-hydric soils in the higher positions of the landform, and map units made up of non-hydric soils may have inclusions of hydric soils in the lower positions of the landform.

References for Hydric Soils

(1) Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

(2) Environmental Laboratory, U>S> Army Corps of Engineers. 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Mississippi.

(3) Federal Register. July 13, 1994. Changes in hydric soils of the United States.

(4) Federal Register. February 24, 1995. Hydric soils of the United States.

(5) National Research Council. 1995. Wetlands: Characteristics and boundaries. National Academy Press, Washington, DC.

(6) Tiner, R.W., Jr. 1985. Wetlands of Delaware. Cooperative Publication, U.S. Fish and Wildlife Service, Newton Corner, Massachusetts, and Delaware Department of Natural Resources and Environmental Control, Wetlands Section, Dover, Delaware.

(7) United States Department of Agriculture, Soil Conservation Service. 1975. Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Survey Staff, United States Department of Agriculture Handbook 436.

(8) United States Department of Agriculture, Soil Conservation Service. 1993. Soil survey manual. Soil Survey Staff, United States Department of Agriculture Handbook 18.

(9) United States Department of Agriculture, Soil Conservation Service. 1994. Keys to soil taxonomy. Sixth edition. Soil Survey Staff.

(10) United States Department of Agriculture, Natural Resources Conservation Service. 1996. Field indicators of hydric soils in the United States. G.W. Hurt, P.M. Whited, and R.F. Pringle, eds.

Hydric Soils of the United States

Introduction

The definition of 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. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. Soils that are sufficiently wet because of artificial measures are included in the concept of *hydric soils*. Also, soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric. Some series, designated as hydric, have phases that are not hydric depending on water table, flooding, and ponding characteristics.

The list of *hydric soils* was created by computer using criteria that were developed by the National Technical Committee for Hydric Soils. The criteria are selected soil properties that are documented in Soil Taxonomy (Soil Survey Staff , 1999) and were designed primarily to generate a list of *hydric soils* from the national database of Map Unit Interpretation Records (MUIR). Criteria 1, 3, and 4 serve as both database criteria and as indicators for identification of *hydric soils*. Criterion 2 serves only to retrieve soils from the database.

In addition, the wording of criteria 1 & 2 were changed in 2000 to incorporate recent changes in Soil Taxonomy (Soil Survey Staff, 1999).

IT IS IMPORTANT TO NOTE THAT THESE CHANGES DO NOT CAUSE ANY SOILS TO BE ADDED OR DELETED FROM THE LIST.

Field Indicators are soil characteristics which are documented to be strictly associated only with *hydric soils*. Field Indicators are an efficient on-site means to confirm the presence of *hydric soil*. The Field Indicators are designed to identify soils which meet the *hydric soil* definition without further data collection. Some hydric soils exist for which no Field Indicators have yet been recorded and documented, and to identify these soils as hydric, evidence must be gathered to demonstrate that the definition is met. Additional Field Indicators are being developed and tested.

Hydric Soil lists have a number of agricultural and nonagricultural applications. These include assistance in land-use planning, conservation planning, and assessment of potential wildlife habitat. A combination of the *hydric soil*, hydrophytic vegetation, and hydrology criteria defines wetlands as described in the National Food Security Act Manual (Soil Conservation Service, 1994) and the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). Therefore an area that meets the *hydric soil* criteria must also meet the hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

The general list of *hydric soils* is maintained in a computer file and is updated periodically. The most current list of *hydric soils* may be obtained directly from the USDA-NRCS Hydric Soils Homepage, electronically, or as hardcopy, for the cost of printing from the Natural Resources Conservation Service (NRCS) Project Manager, Statistical Laboratory, Iowa State University, 217 Snedecor Hall, Ames, IA 50011. State lists of *hydric soils* are also available electronically from the USDA-NRCS Hydric Soils Homepage or as hardcopy from the NRCS State Conservationist in each state. The NRCS also maintains, for each conservation district in the United States, lists of map units that contain, or may, in some delineations, contain *hydric soils*. These detailed lists are available by contacting the respective NRCS State Conservationist and are recommended for preliminary use in making wetland determinations. Field Indicators should be used for on-site determinations of hydric soils.

DEFINITION OF HYDRIC SOIL

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.

The following criteria reflect those soils that are likely to meet this definition.

CRITERIA FOR HYDRIC SOILS

1. All Histels except Folistels and Histosols except Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:

   a. Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or

   b. poorly drained or very poorly drained and have either:

   (1) water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in),

   or for other soils

   (2) water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or

   (3) water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

GLOSSARY OF TERMS USED IN DEFINING HYDRIC SOILS

anaerobic:

a situation in which molecular oxygen is virtually absent from the environment.

artificial hydric soil:

a soil that meets the definition of a *hydric soil* as a result of an artificially induced hydrologic regime and did not meet the definition before the artificial measures were applied.

drained:

a condition in which ground or surface water has been removed by artificial means.

flooded:

a condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from the high tides, or any combination of sources.

frequently flooded, ponded, saturated:

a frequency class in which flooding, ponding, or saturation is likely to occur often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

growing season:

the portion of the year when soil temperatures are above biologic zero at 50 cm (19.7"). The following growing season months are assumed for each of the soil temperature regimes of Soil Taxonomy:

Isohyperthermic: January-December

Hyperthermic: February-December
Isothermic: January-December
Thermic: February-October
Isomesic: January-December
Mesic: March-October
Frigid: May-September
Isofrigid: May-September
Cryic: June-August
Hypergelic: July-August
Pergelic: July-August
Subgelic: July-August

hydrophytic vegetation:

plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

long duration:

a duration class in which innundation for a single event ranges from 7 days to 1 month.

permeability:

the ease with which water passes through a bulk mass of soil or a layer of soil. In the Map Unit Interpretation Record (MUIR) database, permeability is expressed as the number of inches per hour that water moves downward through the saturated soil.

phase, soil:

a subdivision of a soil series based on features that affect its use and management (e.g. slope, surface texture, stoniness, and thickness).

ponded:

a condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration.

poorly drained:

water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods.

saturated:

a condition in which all voids (pores) between soil particles are filled with water.

soil series:

a group of soils having horizons similar in differentiating characteristics and arrangements in the soil profile, except for texture of the surface layer.

somewhat poorly drained:

water is removed slowly enough that the soil is wet for significant periods during the growing season.

very long duration:

a duration class in which innundation for a single event is greater than 1 month.

very poorly drained:

water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season.

***water table:**

the upper surface of ground water where the water is at atmospheric pressure. In the Map Unit Interpretation Record (MUIR) database, entries are made for the zone of saturation at the highest average depth during the wettest season. It is at least six inches thick and persists in the soil for more than a few weeks. In other databases, saturation, as defined in Soil Taxonomy (Soil Survey Staff. 1999), is used to identify conditions that refer to water table in Criteria 2.

Literature Cited

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1*, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Soil Conservation Service. 1994. *National Food Security Act Manual. Title 180.* USDA Soil Conservation Service, Washington, D.C.

Soil Survey Staff. 1999. *Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys.* USDA Natural Resources Conservation Service, Agric. Hdbk. 436, U.S. Government Printing Office, Washington, D.C. 869 pp.

Soil Survey Staff. 1994. *National Soil Survey Handbook.* USDA Soil Conservation Service, Washington, D.C.

Hydric Soil Technical Note VT-1
Depleted Matrix and Gleyed Matrix

December 18, 2001

It can sometimes be difficult to identify the matrix color when horizons are loaded with redoximorphic features. The definitions of matrix color in the New England and US hydric soil indicator guides are written differently, however they agree in intent. The matrix color is the dominant color. In horizons that are loaded with redoximorphic concentrations and depletions, the matrix color may constitute less than 50 percent of the horizon.

Do not confuse redoximorphic depletions with a depleted or gleyed matrix. When you are identifying a depleted or gleyed matrix, you are going by the matrix color and not by any redoximorphic depletions that might be in the horizon. Redoximorphic depletions are small bodies of low chroma that are imbedded in the matrix. The definition of redoximorphic depletions is included in both guides.

When dealing with a horizon with no redoximorphic features that fits within the color criteria for a depleted or gleyed matrix, care must be taken not to mis-identify A or E horizons in better-drained soils as having a depleted or gleyed matrix.

Both a depleted and gleyed matrix result from periods of wetness. They are defined by matrix colors and presence of redoximorphic features. In some cases, redoximorphic features are not required. For example, a matrix value of 4 or more and a chroma of 1 or less with or without redoximorphic features fits the criteria for a depleted matrix, or a matrix hue of N with a value of 4 or more fits the criteria of a gleyed matrix.

In the New England guide, A and E horizons are excluded from the definition of a depleted matrix. In the US guide, A and E horizons are included in the definition of a depleted matrix if they have many distinct or prominent redoximorphic concentrations. A and E horizons are not excluded from the definition of a gleyed matrix in either guide.

While A horizons have no defined color criteria, they usually have a matrix value of 3 or less because of an accumulation of organic matter and thus would not fit the definition of either a gleyed or depleted matrix.

In New England, E horizons with a matrix value of 4 or more and chroma of 2 or less are most commonly associated with Spodosols. They are commonly found over spodic horizons with matrix hue of 10YR or redder.

In clay soils with no spodic horizons, such as Vergennes or Scantic soils, E horizons will sometimes be described at or near the surface. These horizons usually result from a movement of clay down in the profile. The E horizon has higher matrix value and/or lower matrix chroma than the horizons below.

In both cases, clay soils and Spodosols, if the area in question has not been subject to prolonged periods of wetness, these E horizons should not be identified as having a gleyed or depleted matrix. Some guidelines to use in determining whether prolonged periods of wetness are occuring are location on the landform, presence of wetland vegetation, and presence of gleyed or depleted matrix colors and/or redoximorphic features lower in the profile.

Questions should be directed to the State Soil Scientist, 802-951-6795, x. 236.