

**USDA** United States  
Department of  
Agriculture

Natural  
Resources  
Conservation  
Service

In cooperation with  
Minnesota Agricultural  
Experiment Station

# Soil Survey of Lac qui Parle County, Minnesota

## Part II



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# How To Use This Soil Survey

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This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the detailed soil map units and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

The **detailed soil maps** can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** in Part I of this survey, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1993. Soil names and descriptions were approved in 1994. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. Assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Soil and Water Conservation Board. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Lac qui Parle County. It is part of the technical assistance furnished to the Lac qui Parle Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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**Cover: This terrace, in an area of Sisseton and Heimdal soils, has a grassed back slope. Terraces reduce the hazard of water erosion.**

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# Detailed Soil Map Unit Legend

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- 31D2—Storden loam, 12 to 18 percent slopes, eroded  
34—Parnell silty clay loam, depressional  
47—Colvin silty clay loam  
51—La Prairie loam, occasionally flooded  
60—Glyndon silt loam  
67—Bearden silty clay loam  
70—Svea loam  
85—Calco silty clay loam, occasionally flooded  
108—McIntosh silt loam  
113—Webster clay loam  
114—Glencoe silty clay loam  
127A—Sverdrup sandy loam, 0 to 2 percent slopes  
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127C—Sverdrup sandy loam, 6 to 12 percent slopes  
137—Dovray silty clay  
141A—Egeland sandy loam, 0 to 2 percent slopes  
141B—Egeland sandy loam, 2 to 6 percent slopes  
141C—Egeland loam, 6 to 12 percent slopes  
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184—Hamerly loam  
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212B—Sinai silty clay, 3 to 6 percent slopes  
219—Rolfe silt loam  
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236—Vallers clay loam  
246—Marysland loam  
276—Oldham silty clay  
284B—Poinsett silty clay loam, 1 to 4 percent slopes  
288F—Esmond loam, 18 to 40 percent slopes  
290B—Rothsay silt loam, 1 to 4 percent slopes  
293B—Swenoda loam, 2 to 6 percent slopes  
314—Spottswood loam  
338—Waubay silty clay loam  
339—Fordville loam  
341A—Arvilla sandy loam, 0 to 2 percent slopes  
341B—Arvilla sandy loam, 2 to 6 percent slopes  
341C—Arvilla sandy loam, 6 to 12 percent slopes  
344—Quam silty clay loam  
347—Malachy loam  
375—Forada loam  
396D2—Sisseton loam, 12 to 18 percent slopes, eroded  
402F—Sioux gravelly loam, 12 to 40 percent slopes  
418—Lamoure silty clay loam, occasionally flooded  
421B—Ves loam, 1 to 4 percent slopes  
423—Seaforth loam  
434—Perella silty clay loam  
437F—Buse loam, 18 to 40 percent slopes  
446—Normania clay loam  
450—Rauville silty clay loam, frequently flooded  
494B—Darnen loam, 2 to 6 percent slopes  
497—Hantho silt loam  
509—Vallers clay loam, very stony  
574—Du Page loam, occasionally flooded  
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# Soil Survey of Lac qui Parle County, Minnesota

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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 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.

Interpretive ratings help engineers, planners, and others understand how soil properties influence important nonagricultural uses, such as building site development and construction materials. The ratings indicate the most restrictive soil features affecting the suitability of the soils for these uses.

Soils are rated in their natural state. No unusual

modification of the soil site or material is made other than that which is considered normal practice for the rated use. Even though soils may have limitations, it is important to remember that engineers and others can modify soil features or can design or adjust the plans for a structure to compensate for most of the limitations. Most of these practices, however, are costly. The final decision in selecting a site for a particular use generally involves weighing the costs of site preparation and maintenance.

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.

The classification and extent of the soils in this survey area are shown in the tables "Classification of the Soils" and "Acreage and Proportionate Extent of the Soils," which are at the end of this section.

## CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Arvilla-----	Sandy, mixed Udic Haploborolls
Barnes-----	Fine-loamy, mixed Udic Haploborolls
Bearden-----	Fine-silty, frigid Aeric Calciaquolls
Bigstone-----	Fine-silty, mixed (calcareous), frigid Cumulic Endoaquolls
Burr-----	Fine, mesic Typic Calciaquolls
Buse-----	Fine-loamy, mixed Udorthentic Haploborolls
Calco-----	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Colvin-----	Fine-silty, frigid Typic Calciaquolls
Darnen-----	Fine-loamy, mixed Pachic Udic Haploborolls
Dovray-----	Fine, montmorillonitic, frigid Cumulic Haplaquolls
Du Page-----	Fine-loamy, mixed, mesic Cumulic Hapludolls
Egeland-----	Coarse-loamy, mixed Udic Haploborolls
Embden-----	Coarse-loamy, mixed Pachic Udic Haploborolls
Esmond-----	Coarse-loamy, mixed Udorthentic Haploborolls
Forada-----	Coarse-loamy, mixed, frigid Typic Endoaquolls
Fordville-----	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Forman-----	Fine-loamy, mixed Udic Argiborolls
Fulda-----	Fine, montmorillonitic, frigid Vertic Epiaquolls
Glencoe-----	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Glyndon-----	Coarse-silty, frigid Aeric Calciaquolls
Hamerly-----	Fine-loamy, frigid Aeric Calciaquolls
Hamlet-----	Fine-loamy, mixed Aquic Haploborolls
Hantho-----	Coarse-silty, mixed Pachic Udic Haploborolls
Harps-----	Fine-loamy, mesic Typic Calciaquolls
Hawick-----	Sandy, mixed, mesic Entic Hapludolls
Heimdahl-----	Coarse-loamy, mixed Udic Haploborolls
La Prairie-----	Fine-loamy, mixed Cumulic Udic Haploborolls
Lakepark-----	Fine-loamy, mixed, frigid Cumulic Haplaquolls
Lamoure-----	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Langhei-----	Fine-loamy, mixed (calcareous), frigid Typic Udorthents
Malachy-----	Coarse-loamy, mixed Pachic Udic Haploborolls
Marysland-----	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
McIntosh-----	Fine-silty, frigid Aeric Calciaquolls
Mehurin-----	Fine, montmorillonitic Aquic Argiborolls
Normania-----	Fine-loamy, mixed, mesic Aquic Haplustolls
Oldham-----	Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls
Parle-----	Fine-loamy, mixed (calcareous), frigid Cumulic Endoaquolls
Parnell-----	Fine, montmorillonitic, frigid Typic Argiaquolls
Perella-----	Fine-silty, mixed, frigid Typic Epiaquolls
Poinsett-----	Fine-silty, mixed Udic Haploborolls
Quam-----	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rauville-----	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Rolfe-----	Fine, montmorillonitic, mesic Typic Argialbolls
Rothsay-----	Coarse-silty, mixed Udic Haploborolls
Seaforth-----	Fine-loamy, mixed, mesic Aquic Calciustolls
Sinai-----	Fine, montmorillonitic Udertic Haploborolls
Sioux-----	Sandy-skeletal, mixed Udorthentic Haploborolls
Sisseton-----	Coarse-loamy, mixed, frigid Typic Eutrochrepts
Spottswood-----	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Storden-----	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Svea-----	Fine-loamy, mixed Pachic Udic Haploborolls
Sverdrup-----	Sandy, mixed Udic Haploborolls
Swanlake-----	Fine-loamy, mixed, mesic Entic Hapludolls
Swenoda-----	Coarse-loamy, mixed Pachic Udic Haploborolls
Tara-----	Fine-silty, mixed Pachic Udic Haploborolls
Vallers-----	Fine-loamy, frigid Typic Calciaquolls
Ves-----	Fine-loamy, mixed, mesic Udic Haplustolls
Waubay-----	Fine-silty, mixed Pachic Udic Haploborolls
Webster-----	Fine-loamy, mixed, mesic Typic Haplaquolls
Yellowbank-----	Loamy, mixed Ruptic-Lithic Haploborolls
Zell-----	Coarse-silty, mixed Udorthentic Haploborolls
Zumbro-----	Sandy, mixed, mesic Entic Hapludolls

## ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
31D2	Storden loam, 12 to 18 percent slopes, eroded-----	148	*
34	Parnell silty clay loam, depressional-----	7,265	1.5
47	Colvin silty clay loam-----	8,192	1.6
51	La Prairie loam, occasionally flooded-----	5,143	1.0
60	Glyndon silt loam-----	989	0.2
67	Bearden silty clay loam-----	3,795	0.8
70	Svea loam-----	9,562	1.9
85	Calco silty clay loam, occasionally flooded-----	14,033	2.8
108	McIntosh silt loam-----	772	0.2
113	Webster clay loam-----	9,347	1.9
114	Glencoe silty clay loam-----	5,646	1.1
127A	Sverdrup sandy loam, 0 to 2 percent slopes-----	537	0.1
127B	Sverdrup sandy loam, 2 to 6 percent slopes-----	7,999	1.6
127C	Sverdrup sandy loam, 6 to 12 percent slopes-----	440	0.1
137	Dovray silty clay-----	6,320	1.3
141A	Egeland sandy loam, 0 to 2 percent slopes-----	925	0.2
141B	Egeland sandy loam, 2 to 6 percent slopes-----	4,699	0.9
141C	Egeland loam, 6 to 12 percent slopes-----	292	0.1
168B	Forman clay loam, 2 to 6 percent slopes-----	5,279	1.1
184	Hamerly loam-----	5,739	1.2
210	Fulda silty clay-----	6,313	1.3
212A	Sinai silty clay loam, 1 to 3 percent slopes-----	1,940	0.4
212B	Sinai silty clay, 3 to 6 percent slopes-----	668	0.1
219	Rolfe silt loam-----	1,791	0.4
220D2	Langhei loam, 12 to 18 percent slopes, eroded-----	581	0.1
236	Vallers clay loam-----	11,005	2.2
246	Marysland loam-----	7,159	1.4
276	Oldham silty clay-----	3,967	0.8
284B	Poinsett silty clay loam, 1 to 4 percent slopes-----	3,673	0.7
288F	Esmond loam, 18 to 40 percent slopes-----	214	*
290B	Rothsay silt loam, 1 to 4 percent slopes-----	8,221	1.6
293B	Swenoda loam, 2 to 6 percent slopes-----	1,535	0.3
314	Spottswood loam-----	378	0.1
338	Waubay silty clay loam-----	12,900	2.6
339	Fordville loam-----	2,050	0.4
341A	Arvilla sandy loam, 0 to 2 percent slopes-----	532	0.1
341B	Arvilla sandy loam, 2 to 6 percent slopes-----	4,670	0.9
341C	Arvilla sandy loam, 6 to 12 percent slopes-----	880	0.2
344	Quam silty clay loam-----	5,065	1.0
347	Malachy loam-----	1,061	0.2
375	Forada loam-----	911	0.2
396D2	Sisseton loam, 12 to 18 percent slopes, eroded-----	932	0.2
402F	Sioux gravelly loam, 12 to 40 percent slopes-----	312	0.1
418	Lamoure silty clay loam, occasionally flooded-----	8,895	1.8
421B	Ves loam, 1 to 4 percent slopes-----	13,262	2.7
423	Seaforth loam-----	4,376	0.9
434	Perella silty clay loam-----	9,670	1.9
437F	Buse loam, 18 to 40 percent slopes-----	939	0.2
446	Normania clay loam-----	14,961	3.0
450	Rauville silty clay loam, frequently flooded-----	7,604	1.5
494B	Darnen loam, 2 to 6 percent slopes-----	2,050	0.4
497	Hantho silt loam-----	6,119	1.2
509	Vallers clay loam, very stony-----	1,744	0.3
574	Du Page loam, occasionally flooded-----	7,310	1.5
597	Tara silt loam-----	4,799	1.0
610	Calco silty clay loam, frequently flooded-----	4,032	0.8
680	Parnell silty clay loam-----	4,957	1.0
694C2	Zell silt loam, 6 to 12 percent slopes, eroded-----	616	0.1
706	Bigstone silty clay loam, ponded-----	4,154	0.8
724	Bigstone silty clay loam-----	1,330	0.3
741B	Poinsett-Buse complex, 2 to 6 percent slopes-----	7,253	1.5
748B	Hamlet loam, 1 to 4 percent slopes-----	7,776	1.6

See footnote at end of table.

## ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
769A	Mehurin clay loam, 0 to 2 percent slopes-----	4,978	1.0
769B	Mehurin clay loam, 2 to 6 percent slopes-----	1,156	0.2
774	Svea loam, very stony-----	1,758	0.4
777C2	Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded-----	2,324	0.5
883	Du Page-Zumbro complex, occasionally flooded-----	497	0.1
891B	Doland-Buse complex, 3 to 6 percent slopes-----	7,088	1.4
902B	Barnes-Buse complex, 2 to 6 percent slopes-----	11,044	2.2
915C2	Buse-Forman complex, 6 to 12 percent slopes, eroded-----	759	0.2
942C2	Langhei-Barnes complex, 6 to 12 percent slopes, eroded-----	1,347	0.3
954B	Ves-Swanlake complex, 3 to 6 percent slopes-----	39,944	8.0
954C2	Storden-Ves complex, 6 to 12 percent slopes, eroded-----	4,311	0.9
969B	Zell-Rothsay complex, 3 to 6 percent slopes-----	7,023	1.4
1013	Pits, quarry-----	26	*
1030	Udorthents-Pits, gravel, complex-----	411	0.1
1051	Glencoe silty clay loam, ponded-----	4,778	1.0
1106C	Storden-Hawick-Ves complex, 6 to 12 percent slopes, eroded-----	595	0.1
1107D	Sisseton-Sioux-Heimdal complex, 6 to 18 percent slopes, eroded-----	561	0.1
1108	Harps-Glencoe-Seaforth complex-----	46,433	9.3
1222	Parle clay loam-----	24,577	4.9
1233B	Esmond-Heimdal complex, 2 to 6 percent slopes-----	14,851	2.9
1266C	Yellowbank-Rock outcrop complex, 1 to 25 percent slopes-----	108	*
1295B	Doland silt loam, 2 to 4 percent slopes, moderately wet-----	1,746	0.4
1296	Swenoda sandy loam, 0 to 2 percent slopes, moderately wet-----	600	0.1
1309C	Buse-Doland complex, 6 to 12 percent slopes, eroded-----	1,544	0.3
1865C	Buse-Barnes complex, 2 to 12 percent slopes, extremely stony-----	2,948	0.6
1865F	Buse loam, 12 to 40 percent slopes, extremely stony-----	849	0.2
1870	Burr-Calco complex, occasionally flooded-----	17,273	3.5
1938	Lakepark loam-----	4,189	0.8
1994	Embden sandy loam-----	4,455	0.9
	Water-----	4,400	0.8
	Total-----	498,300	100.0

\* Less than 0.1 percent.

# Agronomy

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General management needed for crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Natural Resources Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

## Crops and Pasture

Burton Hendrickson, district conservationist, and Curtis Nordaune, soil conservation technician, Natural Resources Conservation Service, helped prepare this section.

In 1989, about 395,000 acres in Lac qui Parle County was cropland (Minnesota Agricultural Statistics Service, 1990). Of this total, 141,000 acres was used for soybeans, 109,000 acres for corn, 72,000 acres for spring wheat, 16,000 acres for oats, and 12,000 acres for hay. Also, about 40,000 acres was enrolled in the Conservation Reserve Program. Sugar beets, edible beans, and specialty crops were grown on the remaining acres. The acreage used for field crops may fluctuate from year to year because of anticipated market prices and weather conditions.

Pasture makes up about 20,000 acres in the county. The pastured areas are mainly in the western and northern parts of the county and adjacent to the various rivers and streams. Some of the soils used as pasture are Buse, Esmond, Svea, and Vallers soils. Most pastures are steep or very steep or are limited for cultivation by such factors as droughtiness, flooding, a very stony surface, or bedrock.

Overgrazing and the failure to apply good management practices can result in poor quality pastures. Production can be increased by deferred or rotation grazing, fertilization, and weed control. Existing grass stands of poor quality can be improved by interseeding and using management practices that enhance the native grass stands or by reseeding

improved and locally adapted introduced grass species. Pasture systems that include a combination of cool- and warm-season grasses can greatly improve production and carrying capacity.

Most of the soils in Lac qui Parle County are well suited to crop production. Productivity can be increased or maintained on most soils by selecting improved crop varieties, using soil conservation practices, maintaining proper fertility levels, irrigating, and applying other good management practices. This soil survey can help in the application of such technology.

The main concerns in managing the cropland in the county are water erosion, wind erosion, droughtiness, wetness, fertility, and tith.

*Water erosion* is a major concern on the sloping and moderately steep soils, such as Barnes, Doland, Forman, Heimdal, Langhei, Sisseton, Storden, Ves, and Zell soils. Measures that help to control erosion include a system of crop residue management, such as minimum tillage, ridge till, and no-till, that leaves crop residue on the surface; terraces; water- and sediment-control structures; contour stripcropping; and grassed waterways.

*Wind erosion* can be a problem on most of the soils in the county. It is a major problem on Arvilla, Bearden, Egeland, Hamerly, and Sverdrup soils. Wind erosion occurs mainly in the winter and spring. It is especially damaging if the soil is dry and bare during periods of high wind. Measures that help to control wind erosion include a system of crop residue management that leaves at least 30 percent of the surface covered with crop residue; field windbreaks; cover crops; and a cropping sequence that includes high-residue crops and rotation hay.

*Droughtiness* is a major problem on Arvilla, Fordville, Sioux, Sverdrup, and Zumbro soils. Species that are planted early and mature early in the season should be selected. Measures that conserve moisture include establishing field windbreaks, planting cover crops, and using a system of conservation tillage that minimizes soil disturbance and leaves large amounts of crop residue on the surface.

*Wetness* can be a problem on poorly drained and

very poorly drained soils, such as Colvin, Dovray, Fulda, Glencoe, Harps, Parnell, and Vallers soils. The use of artificial drainage systems in the southeastern two-thirds of Lac qui Parle County is extensive. The main outlets for drainage systems that consist of tile or shallow surface ditches are rivers and open county ditches. Adequate outlets are difficult to find in the western and northern parts of the county. Drainage of some wet areas may be limited in the future because of the increased importance of maintaining wetlands. Drainage systems must meet a variety of Federal, state, and local regulations.

Properly timed tillage increases productivity on these poorly drained and very poorly drained soils. Tilling when the soil is wet can result in surface compaction. Using a conservation tillage system, such as ridge till, for row crops can help to overcome some of the wetness problems associated with poorly drained soils by minimizing traffic over the field, controlling wheel tracks, and providing an elevated row area during early stages of crop growth.

*Fertility* is a measure of pH level and of the content of plant nutrients in the soil. The soils in the county generally have a low content of phosphorus and a high content of potash and lime. Crops respond to applications of needed fertilizer nutrients. The amount to be applied depends on past and present management, the kind of crop to be grown, and the anticipated level of yields. A soil fertility test is needed to determine nutrient levels and fertilizer needs. The nitrate nitrogen test should be used to determine fertilizer needs. Applications of manure and a rotation that includes legumes can improve nitrogen levels.

*Tilth* is an important factor affecting the germination of seeds and the infiltration of water into the soil. Maintaining good tilth is particularly difficult in areas of very poorly drained soils, such as Bigstone, Dovray, Glencoe, Oldham, and Parnell soils. Tilling at the proper moisture content is critical. Tilling when the soil is too wet can result in surface compaction, which damages soil structure and reduces the rate of water infiltration. It can also result in a cloddy surface, which makes a poor seedbed.

Practices that improve soil tilth include installing a good drainage system where needed, tilling at the proper moisture content, reducing the number of tillage trips across a field, using a crop rotation that includes grasses and legumes, and incorporating organic material, such as manure, crop residue, or straw, into the upper layer of the soil.

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Management Considerations."

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the rate of water infiltration. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture.

Generally, a combination of several practices is needed to control wind erosion and water erosion. Conservation tillage, stripcropping, field windbreaks, contour farming, conservation cropping systems, crop residue management, terraces, diversions, and grassed waterways help to prevent excessive soil loss.

Measures that are effective in maintaining soil fertility include applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to prevent the loss of organic matter and plant nutrients and thus helps to maintain productivity, although the level of fertility can be reduced even in areas where erosion is controlled. All of the soils used for nonirrigated crops respond well to applications of fertilizer.

Some of the considerations shown in the table cannot be easily overcome. These are *channels, flooding, gullies, and ponding*.

Additional considerations are as follows:

*Lime content, limited available water capacity, potential poor tilth and compaction, and restricted permeability.*—These limitations can be minimized by incorporating green manure crops, manure, or crop residue into the soil; applying a system of conservation tillage; and using conservation cropping systems. Also, crops may respond well to additions of phosphate fertilizer in areas where the soils have a high content of lime.

*Potential for ground-water contamination.*—The proper use of nutrients and pesticides can reduce the risk of ground-water contamination.

*Potential for surface-water contamination.*—The risk of surface-water contamination can be reduced by the proper use of nutrients and pesticides and by conservation farming practices that reduce the runoff rate.

*Surface rock fragments.*—This limitation causes rapid wear of tillage equipment. It cannot be easily overcome.

*Surface stones.*—Stones or boulders on or near the surface can hinder normal tillage unless they are removed.

*Salt content.*—In areas where this is a limitation, only salt-tolerant crops should be grown.

On irrigated soils the main management concerns are *efficient water use, nutrient management, control of erosion, pest and weed control, and timely planting and harvesting*. An irrigation system that provides optimum

control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. Also, it can create drainage problems, raise the water table, and increase the salinity of the soils.

### Explanation of Criteria

*Acid soil.*—The pH is less than 6.1.

*Channeled.*—The word “channeled” is included in the map unit name.

*Dense layer.*—The bulk density is 1.80 g/cc or greater within the soil profile.

*Depth to rock.*—The depth to bedrock is less than 40 inches.

*Excessive permeability.*—Permeability is 6 inches per hour or more within the soil profile.

*Flooding.*—Flooding is occasional or frequent.

*Gullied.*—The word “gullied” is included in the map unit name.

*High organic matter content.*—The surface layer has more than 20 percent organic matter.

*Lime content.*—The pH is 7.4 or more in the surface layer, or the wind erodibility group is 4L.

*Limited available water capacity.*—The available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 6 inches or less.

*Limited organic matter content.*—The content of organic matter is 2 percent or less in the surface layer.

*Ponding.*—Ponding duration is assigned to the map unit component. The water table is above the surface.

*Potential poor tilth and compaction.*—The content of clay is 27 percent or more in the surface layer.

*Potential for ground-water contamination (by nutrients or pesticides).*—Depth to the water table is 4 feet or less, the permeability of any layer is more than 6.0 inches per hour, or the depth to bedrock is less than 60 inches.

*Potential for surface-water contamination (by nutrients or pesticides).*—The map unit component is occasionally flooded or frequently flooded, is subject to ponding, is assigned to hydrologic group C or D and has a slope of more than 2 percent, is assigned to hydrologic group A and has a slope of more than 6 percent, or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

*Previously eroded.*—The word “eroded” is included in the map unit name.

*Restricted permeability.*—Permeability is less than 0.06 inch per hour within the soil profile.

*Salt content.*—The electrical conductivity is 4 or more in the surface layer or 8 or more within a depth of 30 inches.

*Slope (equipment limitation).*—The slope is more than 15 percent.

*Surface rock fragments (equipment limitation).*—The terms describing the texture of the surface layer include any rock fragment modifier, except for gravelly, channery, stony, very stony, extremely stony, bouldery, very bouldery, and extremely bouldery.

*Surface stones (equipment limitation).*—The word “stony” or “bouldery” is included in the map unit name or in the description of the surface layer.

*Water erosion.*—Either the slope is 6 percent or more, or the slope is more than 3 percent and less than 6 percent and the surface layer is not sandy.

*Water table.*—A water table is within 2.5 feet of the surface.

*Wind erosion.*—The wind erodibility group is 1, 2, 3, or 4L.

Further information about the management practices described in this section can be obtained from local offices of the Cooperative Extension Service and the Natural Resources Conservation Service.

### Crop Yield Estimates

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the table “Land Capability and Yields per Acre of Crops.” In any given year, yields may be higher or lower than those indicated in the table 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.

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 table 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.

## Land Capability Classification

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 take into account 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, or for engineering purposes.

In the capability system, soils generally are grouped at three levels—capability class, subclass, and unit (USDA, 1961). These categories indicate the degree and kinds of limitations affecting mechanized farming systems that produce the more commonly grown field crops, such as corn, small grain, cotton, hay, and field-grown vegetables. Only class and subclass are used in this survey.

*Capability classes*, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use.

If properly managed, soils in classes 1, 2, 3, and 4 are suitable for the mechanized production of the commonly grown field crops and for pasture and woodland. The degree of the soil limitations affecting the production of cultivated crops increases progressively from class 1 to class 4. The limitations can affect levels of production and the risk of permanent soil deterioration caused by erosion and other factors.

Soils in classes 5, 6, and 7 are generally not suited to the mechanized production of the commonly grown field crops without special management, but they are suitable for plants that provide a permanent cover, such as grasses and trees. The severity of the soil limitations affecting crops increases progressively from class 5 to class 7.

Areas in class 8 are generally not suitable for crops, pasture, or woodland without a level of management

that is impractical. These areas may have potential for other uses, such as recreational facilities and wildlife habitat.

*Capability subclasses* identify the dominant kind of limitation in the class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2*e*. The letter *e* shows that the main hazard is the risk of erosion unless a 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.

There are no subclasses in class 1 because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each soil is given in the table “Land Capability and Yields per Acre of Crops” at the end of this section.

## Prime Farmland

Prime farmland is of major importance in meeting the Nation’s short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation’s prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. An adequate moisture supply and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They either are used for food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for

institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in National forests, National parks, military reservations, and state parks.

Prime farmland soils commonly receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable, and the level of acidity or alkalinity and the content of salts and sodium are acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods, and they are not frequently flooded during the growing season or are protected from flooding. Slopes range mainly from 0 to 6 percent.

Soils that have a high water table or are subject to flooding may qualify as prime farmland where these limitations are overcome by drainage measures or flood control. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information about the criteria for prime farmland can be obtained at the local office of the Natural Resources Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 439,160 acres, or nearly 88 percent of the survey area, meets the requirements for prime farmland.

The map units in the survey area that meet the requirements for prime farmland are listed in the table "Prime Farmland." On some soils included in the table, measures that overcome limitations are needed. The need for these measures is indicated in parentheses after the map unit name. The location of each map unit is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Soil Series and Detailed Soil Map Units" in Part I of this survey. This list does not constitute a recommendation for a particular land use.

## Erosion Factors

Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices.

### Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water.

The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

### Fragment-Free Soil Erodibility (Kf) Factor

This is one of the factors used in the revised Universal Soil Loss Equation. It shows the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

### Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

### Wind Erodibility Groups

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index (I) factor is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEG) having similar percentages of dry soil aggregates larger than 0.84 millimeter.

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

## Windbreaks and Environmental Plantings

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.

Windbreaks are commonly planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil. Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

The table "Windbreaks and Environmental Plantings" shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in this 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 local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a nursery.

### **Windbreak Suitability Groups**

Windbreak suitability groups consist of soils in which the kinds and degrees of the hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are about the same.

*Group 1* consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and do not have free carbonates in the upper 20 inches.

*Group 1K* consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and have free carbonates within 20 inches of the surface. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

*Group 2* consists of poorly drained soils that have been artificially drained and do not have free carbonates in the upper 20 inches. Permeability varies.

*Group 2K* consists of poorly drained or very poorly drained soils that have been artificially drained and have free carbonates within 20 inches of the surface. Permeability varies. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

*Group 2H* consists of very poorly drained soils that have been artificially drained and have more than 16 inches of organic material. Permeability varies.

*Group 2W* consists of very poorly drained soils that are subject to ponding and have been artificially drained. It includes soils that have an organic surface layer up to 16 inches thick. Permeability varies.

*Group 3* consists of soils that are well drained or moderately well drained and are loamy or silty throughout. Permeability is moderate or moderately slow. These soils do not have free carbonates in the upper 20 inches.

*Group 4* consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a silty or loamy surface layer and a clayey subsoil. Permeability is slow or very slow.

*Group 4C* consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a clayey surface layer and subsoil. Permeability is slow or very slow.

*Group 4F* consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a substratum of dense till. Permeability is slow or very slow.

*Group 5* consists of soils that are excessively drained to moderately well drained and have a moderate available water capacity. These soils are dominantly fine sandy loam or sandy loam, but some are sandy in the upper part and loamy in the lower part.

*Group 6G* consists of excessively drained to moderately well drained soils that are loamy in the upper part and have sand or sand and gravel at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

*Group 6D* consists of excessively drained to moderately well drained, loamy soils that have bedrock at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

*Group 7* consists of excessively drained to well drained soils that are dominantly loamy fine sand or coarser textured and are shallow to sand or to sand and gravel. These soils have a low available water capacity.

*Group 8* consists of excessively drained to well drained, loamy soils that have free carbonates within 20 inches of the surface.

*Group 9W* consists of soils that are somewhat poorly drained, poorly drained, or very poorly drained and are moderately saline (the electrical conductivity is 8 to 16).

*Group 10* consists of soils or miscellaneous land

types that generally are not suitable for windbreaks. One or more characteristics, such as soil depth, texture, wetness, available water capacity, or slope, limit the planting, survival, or growth of trees and shrubs.

## CROPLAND MANAGEMENT CONSIDERATIONS

(See text for a description of the considerations listed in this table)

Map symbol and soil name	Cropland management considerations
31D2: Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
34: Parnell-----	Potential for ground-water contamination Potential poor tilth and compaction
47: Colvin-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
51: La Prairie-----	Flooding Potential for ground-water contamination Potential for surface-water contamination
60: Glyndon-----	Lime content Potential for ground-water contamination Water table Wind erosion
67: Bearden-----	Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
70: Svea-----	No major limitations or hazards
85: Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
108: McIntosh-----	Lime content Potential for ground-water contamination Water table Wind erosion

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
113: Webster-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
114: Glencoe-----	Potential for ground-water contamination Potential poor tilth and compaction
127A: Sverdrup-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
127B: Sverdrup-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
127C: Sverdrup-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
137: Dovray-----	Potential for ground-water contamination Potential poor tilth and compaction
141A: Egeland-----	Wind erosion
141B: Egeland-----	Potential for surface-water contamination Water erosion Wind erosion
141C: Egeland-----	Potential for surface-water contamination Water erosion
168B: Forman-----	Potential for surface-water contamination Potential poor tilth and compaction Water erosion
184: Hamerly-----	Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
210: Fulda-----	Potential for ground-water contamination Potential poor tilth and compaction Water table

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
212A: Sinai-----	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction
212B: Sinai-----	Potential for surface-water contamination Potential poor tilth and compaction Restricted permeability Water erosion
219: Rolfe-----	Potential for ground-water contamination
220D2: Langhei-----	Lime content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
236: Vallers-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
246: Marysland-----	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
276: Oldham-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
284B: Poinsett-----	Potential poor tilth and compaction Water erosion
288F: Esmond-----	Lime content Potential for surface-water contamination Slope Water erosion Wind erosion
290B: Rothsay-----	Water erosion
293B: Swenoda-----	Potential for surface-water contamination Water erosion
314: Spottswood-----	Excessive permeability Potential for ground-water contamination

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
338: Waubay-----	Potential for ground-water contamination Potential poor tilth and compaction
339: Fordville-----	Excessive permeability Limited available water capacity Potential for ground-water contamination
341A: Arvilla-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
341B: Arvilla-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
341C: Arvilla-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
344: Quam-----	Potential for ground-water contamination Potential poor tilth and compaction
347: Malachy-----	Excessive permeability Lime content Potential for ground-water contamination Wind erosion
375: Forada-----	Excessive permeability Potential for ground-water contamination Water table
396D2: Sisseton-----	Lime content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
402F: Sioux-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
418: Lamoure-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
421B: Ves-----	Water erosion
423: Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
434: Perella-----	Potential for ground-water contamination Water table
437F: Buse-----	Lime content Potential for surface-water contamination Slope Water erosion Wind erosion
446: Normania-----	Potential for ground-water contamination Potential poor tilth and compaction
450: Rauville-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction
494B: Darnen-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
497: Hantho-----	Potential for ground-water contamination
509: Vallars-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Surface stones Water table Wind erosion
574: Du Page-----	Flooding Potential for surface-water contamination
597: Tara-----	Potential for ground-water contamination

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
610: Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
680: Parnell-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
694C2: Zell-----	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
706: Bigstone-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction
724: Bigstone-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Wind erosion
741B: Poinsett-----	Potential for surface-water contamination Potential poor tilth and compaction Water erosion
Buse-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
748B: Hamlet-----	Potential for ground-water contamination Water erosion
769A: Mehurin-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
769B: Mehurin-----	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion Water table
774: Svea-----	Surface stones

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
777C2: Sisseton-----	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Heimdal-----	Potential for surface-water contamination Previously eroded Water erosion
883: Du Page-----	Flooding Potential for surface-water contamination
Zumbro-----	Excessive permeability Flooding Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Wind erosion
891B: Doland-----	Potential for surface-water contamination Water erosion
Buse-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
902B: Barnes-----	Potential for surface-water contamination Water erosion
Buse-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
915C2: Buse-----	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Forman-----	Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Water erosion
942C2: Langhei-----	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Barnes-----	Potential for surface-water contamination Previously eroded Water erosion

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
954B:	
Ves-----	Potential for surface-water contamination Water erosion
Swanlake-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
954C2:	
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Ves-----	Potential for surface-water contamination Previously eroded Water erosion
969B:	
Zell-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
Rothsay-----	Potential for surface-water contamination Water erosion
1013:	
Pits-----	Nonsoil material
1030:	
Udorthents-----	Nonsoil material
Pits-----	Nonsoil material
1051:	
Glencoe-----	Potential for ground-water contamination Potential poor tilth and compaction
1106C:	
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
Ves-----	Potential for surface-water contamination Previously eroded Water erosion

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1107D: Sisseton-----	Lime content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Sioux-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Slope Water erosion
Heimdal-----	Potential for surface-water contamination Previously eroded Slope Water erosion
1108: Harps-----	Lime content Potential for ground-water contamination Water table Wind erosion
Glencoe-----	Potential for ground-water contamination Potential poor tilth and compaction
Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
1222: Parle-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
1233B: Esmond-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
Heimdal-----	Potential for surface-water contamination Water erosion
1266C: Yellowbank-----	Depth to rock Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion
Rock outcrop----	Nonsoil material
1295B: Doland-----	Potential for surface-water contamination Water erosion

## CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1296: Swenoda-----	Potential for ground-water contamination Wind erosion
1309C: Buse-----	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Doland-----	Potential for surface-water contamination Previously eroded Water erosion
1865C: Buse-----	Lime content Potential for surface-water contamination Surface stones Water erosion Wind erosion
Barnes-----	Potential for surface-water contamination Surface stones Water erosion
1865F: Buse-----	Lime content Potential for surface-water contamination Slope Surface stones Water erosion Wind erosion
1870: Burr-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
1938: Lakepark-----	Potential for ground-water contamination Water table
1994: Emlden-----	Wind erosion

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of nonirrigated management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		Bu	Bu	Bu	Bu	Tons
31D2----- Storden	4e	70.0	22.0	29.0	46.0	2.5
34----- Parnell	3w	92.0	30.0	36.0	57.0	2.8
47----- Colvin	2w	105.0	33.0	44.0	70.0	3.7
51----- La Prairie	2w	108.0	36.0	44.0	71.0	3.8
60----- Glyndon	2s	117.0	37.0	48.0	77.0	4.1
67----- Bearden	2e	117.0	37.0	48.0	77.0	4.1
70----- Svea	1	116.0	39.0	47.0	76.0	4.1
85----- Calco	2w	94.0	32.0	38.0	60.0	2.9
108----- McIntosh	2s	113.0	36.0	46.0	73.0	43.9
113----- Webster	2w	110.0	36.0	46.0	73.0	3.9
114----- Glencoe	3w	96.0	32.0	38.0	60.0	3.0
127A----- Sverdrup	3s	54.0	18.0	25.0	40.0	2.4
127B----- Sverdrup	3e	50.0	17.0	23.0	34.0	2.3
127C----- Sverdrup	4e	45.0	15.0	21.0	32.0	2.2
137----- Dovray	3w	80.0	26.0	38.0	60.0	2.4
141A----- Egeland	3s	76.0	24.0	35.0	56.0	2.7
141B----- Egeland	3e	70.0	23.0	33.0	53.0	2.6
141C----- Egeland	4e	60.0	19.0	28.0	45.0	1.5
168B----- Forman	2e	112.0	37.0	45.0	72.0	3.9

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Tons</u>
184----- Hamerly	2s	113.0	36.0	46.0	73.0	3.9
210----- Fulda	2w	94.0	32.0	38.0	60.0	2.9
212A----- Sinai	2s	102.0	34.0	42.0	67.0	3.6
212B----- Sinai	3e	100.0	33.0	40.0	65.0	3.5
219----- Rolfe	3w	92.0	30.0	36.0	57.0	2.8
220D2----- Langhei	6e	65.0	20.0	26.0	42.0	2.3
236----- Vallers	2w	98.0	32.0	41.0	65.0	3.4
246----- Marysland	2w	70.0	21.0	33.0	53.0	2.6
276----- Oldham	2w	86.0	26.0	33.0	52.0	2.5
284B----- Poinsett	2e	118.0	40.0	49.0	78.0	4.1
288F----- Esmond	7e	---	---	---	---	---
290B----- Rothsay	2e	118.0	40.0	49.0	78.0	4.1
293B----- Swenoda	2e	90.0	30.0	38.0	61.0	3.2
314----- Spottswood	2s	78.0	25.0	38.0	60.0	2.8
338----- Waubay	1	120.0	40.0	50.0	80.0	4.2
339----- Fordville	2s	55.0	18.0	25.0	40.0	2.4
341A----- Arvilla	3s	50.0	17.0	24.0	34.0	2.3
341B----- Arvilla	4s	48.0	16.0	22.0	33.0	2.2
341C----- Arvilla	4e	42.0	14.0	---	30.0	2.0
344----- Quam	3w	96.0	32.0	38.0	60.0	3.0
347----- Malachy	2s	72.0	21.0	34.0	54.0	2.7

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		Bu	Bu	Bu	Bu	Tons
375----- Forada	2w	70.0	23.0	33.0	53.0	2.6
396D2----- Sisseton	6e	60.0	18.0	24.0	39.0	2.1
402F----- Sioux	7s	---	---	---	---	---
418----- Lamoure	2w	94.0	32.0	38.0	60.0	2.9
421B----- Ves	2e	118.0	40.0	49.0	78.0	4.1
423----- Seaforth	2s	117.0	37.0	48.0	77.0	4.1
434----- Perella	2w	116.0	36.0	46.0	73.0	3.9
437F----- Buse	7e	---	---	---	---	---
446----- Normania	1	120.0	40.0	50.0	80.0	4.2
450----- Rauville	8w	---	---	---	---	---
494B----- Darnen	2e	110.0	40.0	44.0	78.0	4.1
497----- Hantho	1	120.0	40.0	50.0	80.0	4.2
509----- Vallers	6s	---	---	---	---	---
574----- Du Page	2w	108.0	36.0	44.0	71.0	3.8
597----- Tara	1	120.0	40.0	50.0	80.0	4.2
610----- Calco	5w	---	---	---	---	---
680----- Parnell	2w	98.0	33.0	41.0	65.0	3.4
694C2----- Zell	4e	90.0	27.0	37.0	60.0	3.1
706----- Bigstone	8w	---	---	---	---	---
724----- Bigstone	3w	90.0	27.0	34.0	53.0	2.7

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Tons</u>
741B----- Poinsett-----	2e	102.0	34.0	42.0	67.0	3.6
Buse-----	2e					
748B----- Hamlet	2c	114.0	38.0	46.0	74.0	4.0
769A----- Mehurin	1	110.0	36.0	45.0	72.0	3.7
769B----- Mehurin	2e	105.0	34.0	43.0	70.0	3.5
774----- Svea	6s	---	---	---	---	---
777C2----- Sisseton-----	4e	88.0	26.0	37.0	59.0	3.0
Heimdal-----	3e					
883----- Du Page-----	2w	86.0	28.0	35.0	55.0	2.5
Zumbro-----	3s					
891B----- Doland-----	2e	102.0	34.0	42.0	67.0	3.6
Buse-----	2e					
902B----- Barnes-----	2e	95.0	32.0	40.0	63.0	3.3
Buse-----	2e					
915C2----- Buse-----	3e	88.0	26.0	37.0	59.0	3.0
Forman-----	3e					
942C2----- Langhei-----	4e	88.0	26.0	37.0	59.0	3.0
Barnes-----	3e					
954B----- Ves-----	2e	100.0	34.0	41.0	66.0	3.5
Swanlake-----	2e					
954C2----- Storden-----	3e	91.0	28.0	39.0	61.0	3.2
Ves-----	3e					
969B----- Zell-----	3e	102.0	30.0	42.0	67.0	3.6
Rothsay-----	2e					

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		Bu	Bu	Bu	Bu	Tons
1013----- Pits	8s	---	---	---	---	---
1030. Udorthents  Pits						
1051----- Glencoe	8w	---	---	---	---	---
1106C----- Storden----- Hawick----- Ves-----	3e 4s 3e	86.0	25.0	36.0	57.0	3.0
1107D----- Sisseton----- Sioux----- Heimdal-----	6e 6s 4e	45.0	14.0	22.0	32.0	2.3
1108----- Harps----- Glencoe----- Seaforth-----	2w 3w 2s	105.0	32.0	44.0	70.0	3.7
1222----- Parle	2w	105.0	33.0	44.0	70.0	3.7
1233B----- Esmond----- Heimdal-----	3e 2e	90.0	28.0	38.0	61.0	3.2
1266C----- Yellowbank----- Rock outcrop----	6e 8s	---	---	---	---	---
1295B----- Doland	2e	118.0	40.0	49.0	78.0	4.1
1296----- Svenoda	2s	108.0	36.0	44.0	71.0	3.8
1309C----- Buse----- Doland-----	3e 3e	91.0	28.0	38.0	61.0	3.2
1865C----- Buse----- Barnes-----	6s 6s	---	---	---	---	---

## LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Spring wheat	Oats	Alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Tons</u>
1865F----- Buse	7s	---	---	---	---	---
1870----- Burr----- Calco-----	2w	86.0	26.0	33.0	52.0	2.5
1938----- Lakepark	2w	98.0	33.0	41.0	65.0	3.4
1994----- Embden	2s	80.0	26.0	38.0	60.0	2.8

## PRIME FARMLAND

Map symbol	Soil name
47	Colvin silty clay loam (where drained)
51	La Prairie loam, occasionally flooded
60	Glyndon silt loam
67	Bearden silty clay loam
70	Svea loam
85	Calco silty clay loam, occasionally flooded (where drained)
108	McIntosh silt loam
113	Webster clay loam (where drained)
127A	Sverdrup sandy loam, 0 to 2 percent slopes (where irrigated)
127B	Sverdrup sandy loam, 2 to 6 percent slopes (where irrigated)
141A	Egeland sandy loam, 0 to 2 percent slopes
141B	Egeland sandy loam, 2 to 6 percent slopes
168B	Forman clay loam, 2 to 6 percent slopes
184	Hamerly loam
210	Fulda silty clay (where drained)
212A	Sinai silty clay loam, 1 to 3 percent slopes
236	Vallers clay loam (where drained)
246	Marysland loam (where drained)
284B	Poinsett silty clay loam, 1 to 4 percent slopes
290B	Rothsay silt loam, 1 to 4 percent slopes
293B	Swenoda loam, 2 to 6 percent slopes
314	Spottswood loam
338	Waubay silty clay loam
339	Fordville loam
341A	Arvilla sandy loam, 0 to 2 percent slopes (where irrigated)
341B	Arvilla sandy loam, 2 to 6 percent slopes (where irrigated)
347	Malachy loam
375	Forada loam (where drained)
418	Lamoure silty clay loam, occasionally flooded (where drained)
421B	Ves loam, 1 to 4 percent slopes
423	Seaforth loam
434	Perella silty clay loam (where drained)
446	Normania clay loam
494B	Darnen loam, 2 to 6 percent slopes
497	Hantho silt loam
574	Du Page loam, occasionally flooded
597	Tara silt loam
680	Parnell silty clay loam (where drained)
741B	Poinsett-Buse complex, 2 to 6 percent slopes
748B	Hamlet loam, 1 to 4 percent slopes
769A	Mehurin clay loam, 0 to 2 percent slopes
769B	Mehurin clay loam, 2 to 6 percent slopes
891B	Doland-Buse complex, 3 to 6 percent slopes
902B	Barnes-Buse complex, 2 to 6 percent slopes
954B	Ves-Swanlake complex, 3 to 6 percent slopes
969B	Zell-Rothsay complex, 3 to 6 percent slopes
1108	Harps-Glencoe-Seaforth complex (where drained)
1222	Parle clay loam (where drained)
1233B	Esmond-Heimdal complex, 2 to 6 percent slopes
1295B	Doland silt loam, 2 to 4 percent slopes, moderately wet
1296	Swenoda sandy loam, 0 to 2 percent slopes, moderately wet
1870	Burr-Calco complex, occasionally flooded (where drained)
1938	Lakepark loam (where drained)
1994	Embden sandy loam

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(Only the soils suitable for windbreaks and environmental plantings are listed. The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
31D2: Storden-----	American plum, lilac.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, thornless honeylocust, bur oak.	Eastern cottonwood	---
34: Parnell-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, northern whitecedar.	Eastern cottonwood, golden willow, black willow.	Robusta cottonwood.
47: Colvin-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Manchurian crabapple, Black Hills spruce, ponderosa pine.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.
51: La Prairie-----	American plum-----	Siberian peashrub, eastern redcedar, lilac.	Black Hills spruce, ponderosa pine, Scotch pine.	Green ash, golden willow, black willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
60: Glyndon-----	American plum-----	Siberian peashrub, eastern redcedar, common chokecherry.	Russian-olive, Black Hills spruce, bur oak.	Green ash, golden willow, black willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
67: Bearden-----	American plum-----	Siberian peashrub, eastern redcedar, lilac.	Ponderosa pine, bur oak.	Green ash, golden willow, black willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
70: Svea-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, American plum, lilac.	Sargent crabapple, ponderosa pine, blue spruce.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood.
85: Calco-----	Redosier dogwood, lilac.	Siberian peashrub, gray dogwood, common chokecherry.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, thornless honeylocust, golden willow.	Siouxland cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
108: McIntosh-----	American plum-----	Siberian peashrub, eastern redcedar, lilac.	Hackberry, Black Hills spruce, bur oak.	Green ash, golden willow, laurel willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
113: Webster-----	Nanking cherry----	Redosier dogwood, eastern redcedar, common chokecherry.	Hackberry, ponderosa pine, blue spruce.	Thornless honeylocust, golden willow, American basswood.	Silver maple, eastern cottonwood, robusta cottonwood.
114: Glencoe-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, Russian-olive, green ash.	White willow, golden willow, black willow.	Robusta cottonwood.
127A: Sverdrup-----	Hedge cotoneaster, lilac.	Eastern redcedar, sargent crabapple, silver buffaloberry.	Russian-olive, green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
127B: Sverdrup-----	Hedge cotoneaster, lilac.	Eastern redcedar, sargent crabapple, silver buffaloberry.	Russian-olive, green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
127C: Sverdrup-----	Hedge cotoneaster, lilac.	Eastern redcedar, sargent crabapple, silver buffaloberry.	Russian-olive, green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
137: Dovray-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, Russian-olive, green ash.	Eastern cottonwood, white willow, golden willow.	Robusta cottonwood.
141A: Egeland-----	Siberian peashrub, hedge cotoneaster, Nanking cherry.	Ponderosa pine, American plum, lilac.	Hackberry, Russian-olive, green ash, Manchurian crabapple, Austrian pine.	Thornless honeylocust.	Silver maple, eastern cottonwood.
141B: Egeland-----	Siberian peashrub, hedge cotoneaster, Nanking cherry.	Ponderosa pine, American plum, lilac.	Hackberry, Russian-olive, green ash, Manchurian crabapple, Austrian pine.	Thornless honeylocust.	Silver maple, eastern cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
141C: Egeland-----	Siberian peashrub, hedge cotoneaster, Nanking cherry.	Ponderosa pine, American plum, lilac.	Hackberry, Russian-olive, green ash, Manchurian crabapple, Austrian pine.	Thornless honeylocust.	Silver maple, eastern cottonwood.
168B: Forman-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, Siberian crabapple, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
184: Hamerly-----	American plum-----	Siberian peashrub, eastern redcedar, common chokecherry.	Russian-olive, Black Hills spruce, bur oak.	Green ash, golden willow, black willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
210: Fulda-----	Peking cotoneaster, Nanking cherry, lilac.	Amur maple, Siberian peashrub, hedge cotoneaster, redosier dogwood, eastern redcedar, Black Hills spruce, nannyberry viburnum.	Hackberry, Manchurian crabapple, Norway spruce, Austrian pine, ponderosa pine, blue spruce.	Green ash, thornless honeylocust, golden willow.	Silver maple, Carolina poplar, eastern cottonwood, Siouxland cottonwood.
212A: Sinai-----	American plum, lilac.	Siberian peashrub, eastern redcedar, common chokecherry.	Green ash, Austrian pine, bur oak.	---	Silver maple, eastern cottonwood.
212B: Sinai-----	American plum, lilac.	Siberian peashrub, eastern redcedar, common chokecherry.	Green ash, Austrian pine, bur oak.	---	Silver maple, eastern cottonwood.
219: Rolfe-----	---	Siberian peashrub, redosier dogwood, silver buffaloberry.	Russian-olive, green ash.	Eastern cottonwood, golden willow, black willow.	Robusta cottonwood.
220D2: Langhei-----	American plum, lilac.	Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
236: Vallars-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Russian-olive, blue spruce, silver buffaloberry.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
246: Marysland-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Russian-olive, Black Hills spruce, silver buffaloberry.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.
276: Oldham-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Hackberry, eastern redcedar, Manchurian crabapple, ponderosa pine, blue spruce.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.
284B: Poinsett-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, American plum, lilac.	Russian-olive, Siberian crabapple, ponderosa pine.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
290B: Rothsay-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, green ash, Manchurian crabapple, Austrian pine, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.
293B: Swenoda-----	Siberian peashrub, hedge cotoneaster, Nanking cherry.	Ponderosa pine, American plum, lilac.	Hackberry, Russian-olive, green ash.	Silver maple, thornless honeylocust, eastern cottonwood.	---
314: Spottswood-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, common chokecherry.	Manchurian crabapple, Black Hills spruce, ponderosa pine.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood.
338: Waubay-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, American plum, lilac.	Manchurian crabapple, ponderosa pine, blue spruce.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood.
339: Fordville-----	Hedge cotoneaster, lilac.	Eastern redcedar, Siberian crabapple, common chokecherry.	Green ash, thornless honeylocust, Black Hills spruce, Austrian pine, ponderosa pine.	Silver maple-----	Eastern cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
341A: Arvilla-----	Hedge cotoneaster, lilac.	Siberian peashrub, eastern redcedar, Siberian crabapple, common chokecherry.	Green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
341B: Arvilla-----	Hedge cotoneaster, lilac.	Siberian peashrub, eastern redcedar, Siberian crabapple, common chokecherry.	Green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
341C: Arvilla-----	Hedge cotoneaster, lilac.	Siberian peashrub, eastern redcedar, Siberian crabapple, common chokecherry.	Green ash, thornless honeylocust, ponderosa pine.	Silver maple-----	Eastern cottonwood.
344: Quam-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, Russian-olive, green ash, northern whitecedar.	White willow, golden willow, black willow.	Robusta cottonwood.
347: Malachy-----	American plum-----	Siberian peashrub, eastern redcedar, common chokecherry.	Russian-olive, Black Hills spruce, bur oak.	Green ash, golden willow, black willow.	Thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
375: Forada-----	Peking cotoneaster, Nanking cherry, lilac.	Amur maple, Siberian peashrub, redosier dogwood, American plum.	Manchurian crabapple, Austrian pine, blue spruce.	Green ash, thornless honeylocust, golden willow.	Silver maple, Carolina poplar, eastern cottonwood, Siouxland cottonwood.
396D2: Sisseton-----	American plum, lilac.	Hackberry, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
418: Lamoure-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Hackberry, eastern redcedar, Manchurian crabapple, ponderosa pine, blue spruce.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
421B: Ves-----	Nanking cherry----	Siberian peashrub, gray dogwood, redosier dogwood, lilac.	Russian-olive, eastern redcedar, Black Hills spruce, bur oak.	Hackberry, green ash, black walnut.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.
423: Seaforth-----	---	Siberian peashrub, American plum, lilac.	Hackberry, eastern redcedar, ponderosa pine, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
434: Perella-----	Nanking cherry, lilac.	Siberian peashrub, hedge cotoneaster, American plum.	Hackberry, Siberian crabapple, ponderosa pine, blue spruce.	Green ash, golden willow, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood.
437F: Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
446: Normania-----	Nanking cherry----	Redosier dogwood, American plum, chokecherry, lilac.	Amur maple, eastern redcedar, blue spruce, bur oak.	Green ash, golden willow, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood, laurel willow.
494B: Darnen-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Amur maple, Siberian peashrub, eastern redcedar, American plum, silver buffaloberry, lilac.	Russian-olive, green ash, Manchurian crabapple, ponderosa pine, blue spruce.	Hackberry, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
497: Hantho-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, green ash, Manchurian crabapple, ponderosa pine, blue spruce.	Hackberry, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
509: Vallars-----	Redosier dogwood, lilac.	Siberian peashrub, American plum, common chokecherry.	Russian-olive, blue spruce, silver buffaloberry.	Green ash, eastern cottonwood, golden willow.	Siouxland cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
574: Du Page-----	---	Siberian peashrub, American plum, lilac.	Hackberry, eastern redcedar, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
597: Tara-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, redosier dogwood, American plum, common chokecherry.	Manchurian crabapple, ponderosa pine, blue spruce.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood, Siouxland cottonwood.
610: Calco-----	Redosier dogwood, lilac.	Siberian peashrub, gray dogwood, common chokecherry.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, thornless honeylocust, golden willow.	Siouxland cottonwood.
680: Parnell-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Russian-olive, green ash, northern whitecedar.	White willow, golden willow, black willow.	Robusta cottonwood.
694C2: Zell-----	American plum, lilac.	Siberian peashrub, hackberry, Russian-olive, eastern redcedar.	Green ash, ponderosa pine, eastern cottonwood, bur oak.	---	---
724: Bigstone-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, Russian-olive, green ash.	Eastern cottonwood, golden willow, black willow.	Robusta cottonwood.
741B: Poinsett-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, Siberian crabapple, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, eastern cottonwood, bur oak.	---	---
748B: Hamlet-----	Peking cotoneaster, redosier dogwood, Nanking cherry, lilac.	Siberian peashrub, eastern redcedar, Siberian crabapple, Austrian pine, American plum.	Russian-olive, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
769A, 769B: Mehurin-----	Peking cotoneaster, Nanking cherry, lilac.	Siberian peashrub, sargent crabapple, American plum.	Ponderosa pine, blue spruce, American basswood.	Green ash, thornless honeylocust, golden willow.	Silver maple, eastern cottonwood.
774: Svea-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, American plum, lilac.	Sargent crabapple, ponderosa pine, blue spruce.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood.
777C2: Sisseton-----	American plum, lilac.	Siberian peashrub, hackberry, Russian-olive, eastern redcedar.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
Heimdal-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Amur maple, Siberian peashrub, American plum, silver buffaloberry, lilac.	Hackberry, Russian-olive, green ash, Black Hills spruce, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, eastern cottonwood, robusta cottonwood.
883: Du Page-----	---	Siberian peashrub, American plum, lilac.	Hackberry, Russian-olive, eastern redcedar, bur oak.	Green ash, thornless honeylocust, golden willow, laurel willow.	Eastern cottonwood, Siouxland cottonwood.
Zumbro-----	Nanking cherry----	Siberian peashrub, redosier dogwood, American plum, common chokecherry, lilac.	Amur maple, eastern redcedar, blue spruce, bur oak.	Green ash, golden willow, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood, laurel willow.
891B: Doland-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, green ash, Manchurian crabapple, ponderosa pine, blue spruce.	Hackberry, thornless honeylocust, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.
Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
902B: Barnes-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, Siberian crabapple, Austrian pine, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood, Siberian elm.	---
915C2: Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood, Siberian elm.	---
Forman-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Hackberry, Russian-olive, Siberian crabapple, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
942C2: Langhei-----	American plum, lilac.	Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
Barnes-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, Siberian crabapple, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
954B: Ves.					
Swanlake-----	American plum, lilac.	Siberian peashrub, hackberry, eastern redcedar.	Russian-olive, green ash, honeylocust, ponderosa pine.	Eastern cottonwood	---
954C2: Storden-----	American plum, lilac.	Siberian peashrub, hackberry, eastern redcedar.	Russian-olive, green ash, honeylocust, ponderosa pine.	Eastern cottonwood	---
Ves-----	Nanking cherry----	Siberian peashrub, gray dogwood, lilac.	Russian-olive, eastern redcedar, Black Hills spruce, bur oak.	Hackberry, green ash, black walnut.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
969B: Zell-----	American plum, lilac.	Siberian peashrub, hackberry, Russian-olive, eastern redcedar.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
Rothsay-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, green ash, Manchurian crabapple, Austrian pine, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.
1106C: Storden-----	American plum, lilac.	Siberian peashrub, hackberry, eastern redcedar.	Russian-olive, green ash, honeylocust, ponderosa pine.	Eastern cottonwood	---
Hawick. Ves-----	Nanking cherry----	Siberian peashrub, gray dogwood, lilac.	Russian-olive, eastern redcedar, Black Hills spruce, bur oak.	Hackberry, green ash, black walnut.	Silver maple, eastern cottonwood, Siouxland cottonwood, robusta cottonwood.
1107D: Sisseton-----	American plum, lilac.	Siberian peashrub, hackberry, Russian-olive, eastern redcedar.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
Sioux. Heimdal-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, American plum, common chokecherry.	Hackberry, Russian-olive, green ash, Black Hills spruce, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, eastern cottonwood, robusta cottonwood.
1108: Harps-----	Redosier dogwood, lilac.	Siberian peashrub, gray dogwood, common chokecherry.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, thornless honeylocust, golden willow.	Siouxland cottonwood.
Glencoe-----	Redosier dogwood	Siberian peashrub, gray dogwood, silver buffaloberry.	Hackberry, Russian-olive, green ash.	White willow, golden willow, black willow.	Robusta cottonwood.
Seaforth-----	---	Siberian peashrub, American plum, lilac.	Hackberry, eastern redcedar, ponderosa pine, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1233B: Esmond-----	Siberian peashrub, eastern redcedar, American plum, lilac.	Hackberry, Russian-olive, bur oak.	Green ash, ponderosa pine.	Eastern cottonwood	---
Heimdal-----	Siberian peashrub, Peking cotoneaster, redosier dogwood, Nanking cherry, silver buffaloberry.	Amur maple, green ash, Black Hills spruce, American plum, lilac.	Hackberry, Russian-olive, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, eastern cottonwood, robusta cottonwood.
1295B: Doland-----	Siberian peashrub, Peking cotoneaster, redosier dogwood, Nanking cherry.	Russian-olive, eastern redcedar, ponderosa pine, American plum, lilac.	Green ash, Manchurian crabapple, blue spruce.	Hackberry, thornless honeylocust, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
1296: Swenoda-----	Siberian peashrub, hedge cotoneaster, Nanking cherry.	Ponderosa pine, American plum, lilac.	Hackberry, Russian-olive, green ash.	Thornless honeylocust.	Silver maple, eastern cottonwood.
1309C: Buse-----	Russian-olive, Black Hills spruce, American plum, lilac.	Siberian peashrub, eastern redcedar, ponderosa pine.	Green ash, bur oak	Eastern cottonwood	---
Doland-----	Siberian peashrub, Peking cotoneaster, redosier dogwood, Nanking cherry.	Russian-olive, eastern redcedar, ponderosa pine, American plum, lilac.	Green ash, Manchurian crabapple, blue spruce.	Hackberry, thornless honeylocust, robusta cottonwood, American basswood.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1865C: Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---
Barnes-----	Peking cotoneaster, redosier dogwood, Nanking cherry.	Siberian peashrub, eastern redcedar, American plum, lilac.	Russian-olive, Siberian crabapple, Austrian pine, ponderosa pine, blue spruce.	Thornless honeylocust, black walnut, American basswood.	Silver maple, Siouxland cottonwood, robusta cottonwood.
1865F: Buse-----	American plum, lilac.	Siberian peashrub, Russian-olive, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, bur oak.	Eastern cottonwood	---

## WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1870: Burr-----	Redosier dogwood, sargent crabapple.	Siberian peashrub, silver buffaloberry, lilac.	Hackberry, Russian-olive, eastern redcedar, ponderosa pine.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
Calco-----	Redosier dogwood, lilac.	Siberian peashrub, gray dogwood, common chokecherry.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, thornless honeylocust, golden willow.	Siouxland cottonwood.
1994: Emden-----	Peking cotoneaster, Nanking cherry.	Siberian peashrub, American plum, lilac.	Sargent crabapple, ponderosa pine.	Green ash, golden willow, American basswood.	Silver maple, thornless honeylocust, eastern cottonwood.

## WINDBREAK SUITABILITY GROUPS

(Suitable shrubs and trees with their mature heights are listed in the adjoining "Windbreaks and Environmental Plantings" table. Absence of an entry indicates that a windbreak suitability group is not assigned)

Soil name and map symbol	Windbreak suitability group
31D2----- Storden	8
34----- Parnell	2W
47----- Colvin	2K
51----- La Prairie	1
60----- Glyndon	1K
67----- Bearden	1K
70----- Svea	1
85----- Calco	2K
108----- McIntosh	1K
113----- Webster	2
114----- Glencoe	2W
127A, 127B, 127C- Sverdrup	6G
137----- Dovray	2W
141A, 141B, 141C- Egeland	5
168B----- Forman	3
184----- Hamerly	1K
210----- Fulda	2
212A, 212B----- Sinai	4C
219----- Rolfe	2

## WINDBREAK SUITABILITY GROUPS--Continued

Soil name and map symbol	Windbreak suitability group
220D2----- Langhei	8
236----- Vallers	2K
246----- Marysland	2K
276----- Oldham	2
284B----- Poinsett	3
288F----- Esmond	10
290B----- Rothsay	3
293B----- Svenoda	5
314----- Spottswood	1
338----- Waubay	1
339B----- Fordville	6
341A, 341B----- Arvilla	6
341C----- Arvilla	10
344----- Quam	2W
347----- Malachy	1K
375----- Forada	2
396D2----- Sisseton	8
402F----- Sioux	10
418----- Lamoure	2K
421B----- Ves	3
423----- Seaforth	1K
434----- Perella	1

## WINDBREAK SUITABILITY GROUPS--Continued

Soil name and map symbol	Windbreak suitability group
437F----- Buse	8
446----- Normania	1
450----- Rauville	10
494B----- Darnen	3
497----- Hantho	3
509----- Vallers	10
574----- Du Page	1K
597----- Tara	1
610----- Calco	10
680----- Parnell	2
694C2----- Zell	8
706----- Bigstone	10
724----- Bigstone	2K
741B: Poinsett-----	3
Buse-----	8
748B----- Hamlet	1
769A, 769B----- Mehurin	4
774----- Svea	10
777C2: Sisseton-----	8
Heimdal-----	3
883: Du Page-----	1K
Zumbro-----	1

## WINDBREAK SUITABILITY GROUPS--Continued

Soil name and map symbol	Windbreak suitability group
891B: Doland-----	3
Buse-----	8
902B: Barnes-----	3
Buse-----	8
915C2: Buse-----	8
Forman-----	3
942C2: Langhei-----	8
Barnes-----	3
954B: Ves-----	3
Swanlake-----	8
954C2: Storden-----	8
Ves-----	3
969B: Zell-----	8
Rothsay-----	3
1051----- Glencoe	10
1106C: Storden-----	8
Hawick-----	7
Ves-----	3
1107D: Sisseton-----	8
Sioux-----	10
Heimdal-----	3
1108: Harps-----	2K
Glencoe-----	2W
Seaforth-----	1K
1222----- Parle	2K

## WINDBREAK SUITABILITY GROUPS--Continued

Soil name and map symbol	Windbreak suitability group
1233B:	
Esmond-----	8
Heimdahl-----	3
1266:	
Yellowbank-----	10
Rock outcrop.	
1295B-----	3
Doland	
1296-----	1
Swenoda	
1309C:	
Buse-----	8
Doland-----	3
1865C:	
Buse-----	8
Barnes-----	3
1865F-----	10
Buse	
1870:	
Burr-----	2K
Calco-----	2K
1938-----	2
Lakepark	
1994-----	1
Embden	

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# Recreation

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Glenn Carlson, technician, Lac qui Parle Soil and Water Conservation District, helped prepare this section.

Lac qui Parle County provides many opportunities for hunting, fishing, canoeing, hiking, camping, bird watching, and other outdoor activities.

Lac qui Parle State Park, which is 15 miles east of Madison, offers facilities for overnight camping, swimming, hiking, cross-country skiing, horseback riding, and picnics. Lac qui Parle County Park, which is 8 miles northeast of Dawson on the Lac qui Parle River, is less extensively developed than Lac qui Parle State Park but is used for picnics, horseback riding, hiking, river canoeing, cross-country skiing, and snowmobiling.

Each community in the county has a city park with facilities ranging from picnic and playground areas only to athletic complexes and camping facilities. The cities of Dawson and Madison also have 9-hole golf courses that are open to the public.

Lac qui Parle Lake, Marsh Lake, and the Big Stone Wildlife Refuge provide public accesses for boating and fishing. There are also many hunting opportunities in the sloughs and wildlife management areas scattered throughout the county.

Salt Lake in Mehurin Township serves as a migratory stop for geese, ducks, and many other bird species. This is a popular area for bird watching.

The soils of the survey area are rated in the table "Recreational Development" 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, the ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and

frequency of flooding is essential in planning recreational facilities.

*Camp areas* are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These 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 soils are rated on the basis of soil properties that influence the ease of developing camp areas and performance of the areas after development. Also considered are the soil properties that influence trafficability and promote the growth of vegetation after heavy use.

*Picnic areas* are natural or landscaped tracts of land that are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, should remain firm under heavy foot traffic, and should not be dusty when dry.

*Playgrounds* are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and that can withstand heavy foot traffic and maintain an adequate cover of vegetation. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, should remain firm under heavy foot traffic, and should not be dusty when dry.

*Paths and trails* are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. The soils are rated on the basis of soil properties that influence trafficability and erodibility. Paths and trails should remain firm under foot traffic and should not be dusty when dry.

*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.

The interpretive ratings in this table help engineers, planners, and others to understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

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

*Slight* means that soil properties are favorable for the rated use. The limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

*Moderate* means that soil properties are moderately favorable for the rated use. The limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than that of soils rated *slight*.

*Severe* means that soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

The information in the table "Recreational Development" can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in the table "Building Site Development" and interpretations for septic tank absorption fields in the table "Sanitary Facilities."

## RECREATIONAL DEVELOPMENT

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
31D2: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
34: Parnell-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
47: Colvin-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
51: La Prairie-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
60: Glyndon-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
67: Bearden-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness.	Slight-----	Slight.
70: Svea-----	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Slight.
85: Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
108: McIntosh-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
113: Webster-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
114: Glencoe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
127A: Sverdrup-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
127B: Sverdrup-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
127C: Sverdrup-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
137: Dovray-----	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
141A: Egeland-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
141B: Egeland-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
141C: Egeland-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
168B: Forman-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
184: Hamerly-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
210: Fulda-----	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
212A: Sinai-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
212B: Sinai-----	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Slight-----	Severe: too clayey.
219: Rolfe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
220D2: Langhei-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
236: Vallars-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
246: Marysland-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
276: Oldham-----	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
284B: Poinsett-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
288F: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
290B: Rothsay-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
293B: Swenoda-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
314: Spottswood-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
338: Waubay-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
339: Fordville-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
341A: Arvilla-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
341B: Arvilla-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
341C: Arvilla-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
344: Quam-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
347: Malachy-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
375: Forada-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
396D2: Sisseton-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
402F: Sioux-----	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty.
418: Lamoure-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
421B: Ves-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
423: Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
434: Perella-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight-----	Slight.
437F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
446: Normania-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
450: Rauville-----	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
494B: Darnen-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
497: Hantho-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
509: Vallars-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
574: Du Page-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
597: Tara-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
610: Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
680: Parnell-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
694C2: Zell-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
706: Bigstone-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
724: Bigstone-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
741B: Poinsett-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Buse-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
748B: Hamlet-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
769A: Mehurin-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.
769B: Mehurin-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
774: Svea-----	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Slight.
777C2: Sisseton-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Heimdal-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
883: Du Page-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
Zumbro-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
891B: Doland-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Buse-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
902B: Barnes-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
Buse-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
915C2: Buse-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Forman-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
942C2: Langhei-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Barnes-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
954B: Ves-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Swanlake-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
954C2: Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Ves-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
969B: Zell-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Rothsay-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1013: Pits-----	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight-----	Severe: depth to rock.
1030: Udorthents.  Pits.					
1051: Glencoe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1106C: Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Hawick-----	Moderate: slope, small stones.	Moderate: slope.	Severe: slope, small stones.	Slight-----	Severe: too sandy.
Ves-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
1107D: Sisseton-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Sioux-----	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight-----	Severe: droughty.
Heimdal-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1108: Harps-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Glencoe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1222: Parle-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1233B: Esmond-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Heimdal-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
1266C: Yellowbank-----	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight-----	Severe: depth to rock.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----	Severe: depth to rock.
1295B: Doland-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1296: Svenoda-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
1309C: Buse-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Doland-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
1865C: Buse-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
Barnes-----	Severe: large stones.	Severe: large stones.	Severe: large stones, slope.	Slight-----	Moderate: large stones.
1865F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1870: Burr-----	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

## RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1938: Lakepark-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1994: Embden-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.

# Wildlife Habitat

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Steve Merchant, Minnesota Department of Natural Resources, helped prepare this section.

The abundance and diversity of wildlife in Lac qui Parle County are directly related to the soils and land use. The soils in the county have the capability of producing an abundance of wildlife. Land use, however, is the major limiting factor regulating wildlife numbers.

The county is seated within the prairie pothole region of North America. This region has been historically important for the production of a large variety of waterfowl. Wetlands and surrounding tall and mid grass prairies covered the area and offered abundant cover for numerous waterfowl species, shore birds, upland nesting birds, and mammals and a host of nongame birds.

Much of the county's remaining wildlife habitat is in public ownership. Within the county, there are 43 State Wildlife Management Areas, a National Wildlife Refuge, and 15 United States Fish and Wildlife Service Waterfowl Production Areas. These areas afford permanent protection to wetlands, remnant prairies, and river bottoms.

Numerous waterfowl and shore bird species find the wetlands attractive during migration. Mallards, blue-winged teal, wood ducks, and giant Canada geese are common nesting waterfowl. Giant Canada geese have become very abundant in the county. Upland sandpipers and marbled godwits still nest here.

Red fox, mink, muskrat, and beaver are all common furbearers that inhabit the fields and marshes of the county. White-tailed deer are abundant. They are attracted by the river bottoms and large wetlands as wintering areas.

Pheasant and gray partridge numbers are strongly related to land use practices. Recent long-term retirement programs have had a positive effect on pheasant populations.

Lac qui Parle Lake and the Minnesota River provide abundant fisheries resources. The fish species most often sought by anglers are walleye, northern pike, yellow perch, black crappie, and white crappie.

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. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing the existing plant cover, and fostering the natural establishment of desirable plants.

## Elements of Wildlife Habitat

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are corn, soybeans, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are brome grass, timothy, orchardgrass, clover, alfalfa, wheatgrass, and birdsfoot trefoil.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestems, indiangrass, blueberry, goldenrod, lambsquarters, dandelions, blackberry, ragweed, wheatgrass, and nightshade.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity, and flooding. The length of the growing season also is important.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, box elder, birch, maple, green ash, willow, and American elm. Examples of fruit-producing shrubs that are suitable for planting on soils that have good potential for these plants are hawthorn, honeysuckle, American plum, redosier dogwood, chokecherry, serviceberry, silver buffaloberry, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or

ground cover that provide habitat or supply food in the form of browse, seed, or fruit-like cones. Examples are pine, spruce, cedar, and tamarack.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Examples are mountainmahogany, bitterbrush, snowberry, and sagebrush.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of root zone, the amount of water available to plants, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweeds, wild millet, rushes, sedges, bulrushes, wild rice, arrowhead, waterplantain, cattail, prairie cordgrass, bluejoint grass, asters, and beggarticks.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water

areas are depth to bedrock, wetness, surface stoniness, slope, and permeability.

### **Kinds of Wildlife Habitat**

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include Hungarian partridge, ring-necked pheasant, sharp-tailed grouse, meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include wild turkey, ruffed grouse, thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, white-tailed deer, black bear, and moose.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas, bogs, or flood plains that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, bitterns, rails, kingfishers, muskrat, otter, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. The wildlife attracted to this habitat include antelope, deer, sage grouse, meadowlark, and lark bunting.

## WILDLIFE HABITAT

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
31D2: Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
34: Parnell-----	Fair	Fair	Poor	Poor	Very poor.	Poor	Good	Good	Fair	Poor	Good	Poor.
47: Colvin-----	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	Fair.
51: La Prairie-----	Good	Good	Good	---	---	Good	Poor	Poor	Good	---	Poor	Good.
60: Glyndon-----	Good	Good	Good	Fair	Poor	Fair	Poor	Poor	Good	Fair	Poor	Fair.
67: Bearden-----	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair.
70: Svea-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
85: Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
108: McIntosh-----	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Good.
113: Webster-----	Good	Good	Good	Fair	Poor	---	Good	Good	Good	Fair	Good	---
114: Glencoe-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
127A, 127B: Sverdrup-----	Fair	Fair	Fair	Fair	Fair	---	Poor	Very poor.	Fair	Fair	Poor	---
127C: Sverdrup-----	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	---
137: Dovray-----	Poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
141A, 141B: Egeland-----	Fair	Fair	Good	Fair	Very poor.	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Good.
141C: Egeland-----	Very poor.	Fair	Good	Poor	Very poor.	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Good.
168B: Forman-----	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
184: Hamerly-----	Good	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair.

## WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
210: Fulda-----	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair	Fair.
212A, 212B: Sinai-----	Fair	Fair	Good	Fair	Very poor.	---	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
219: Rolfe-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
220D2: Langhei-----	Fair	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
236: Vallers-----	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair.
246: Marysland-----	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
276: Oldham-----	Good	Good	Fair	Good	Poor	---	Fair	Fair	Good	Poor	Fair	Fair.
284B: Poinsett-----	Good	Good	Good	Good	Very poor.	---	Poor	Very poor.	Good	Very poor.	Very poor.	Good.
288F: Esmond-----	Very poor.	Very poor.	Good	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
290B: Rothsay-----	Good	Good	Fair	Fair	Fair	---	Poor	Very poor.	Good	Fair	Poor	---
293B: Swenoda-----	Fair	Fair	Good	Good	Very poor.	---	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
314: Spottswood-----	Good	Good	Fair	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.	Fair.
338: Waubay-----	Good	Good	Good	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
339: Fordville-----	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
341A, 341B: Arvilla-----	Fair	Good	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
341C: Arvilla-----	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
344: Quam-----	Fair	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	Poor.

## WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
347: Malachy-----	Fair	Fair	Good	Fair	Fair	---	Fair	Fair	Fair	Fair	Fair	---
375: Forada-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
396D2: Sisseton-----	Very poor.	Very poor.	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
402F: Sioux-----	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
418: Lamoure-----	Good	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair.
421B: Ves-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
423: Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
434: Perella-----	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair.
437F: Buse-----	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
446: Normania-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
450: Rauville-----	Very poor.	Poor	Fair	Very poor.	Very poor.	Fair	Good	Good	Very poor.	Very poor.	Fair	Fair.
494B: Darnen-----	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair.
497: Hantho-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
509: Vallers-----	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair.
574: Du Page-----	Good	Good	Good	Good	Good	---	Poor	Fair	Good	Good	Poor	---
597: Tara-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
610: Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
680: Parnell-----	Good	Good	Fair	Good	Fair	---	Good	Good	Good	Fair	Good	---

## WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
694C2: Zell-----	Very poor.	Fair	Fair	Poor	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
706: Bigstone-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
724: Bigstone-----	Fair	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	---
741B: Poinsett-----	Good	Good	Good	Good	Very poor.	---	Poor	Very poor.	Good	Very poor.	Very poor.	Good.
Buse-----	Good	Good	Fair	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Fair.
748B: Hamlet-----	Good	Good	Good	---	---	Good	Poor	Poor	Good	---	Poor	Good.
769A, 769B: Mehurin-----	Good	Good	Good	Fair	Poor	Fair	Poor	Poor	Good	Fair	Poor	---
774: Svea-----	Very poor.	Fair	Good	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Good.
777C2: Sisseton-----	Very poor.	Very poor.	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Heimdal-----	Fair	Good	Good	Fair	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	---
883: Du Page-----	Good	Good	Good	Good	Good	---	Poor	Fair	Good	Good	Poor	---
Zumbro-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Poor	---
891B: Doland-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Buse-----	Good	Good	Fair	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Fair.
902B: Barnes-----	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
Buse-----	Good	Good	Fair	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Fair.
915C2: Buse-----	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Forman-----	Fair	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Fair.

## WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
942C2: Langhei-----	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Barnes-----	Fair	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Fair.
954B: Ves-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Swanlake-----	Good	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Fair	Very poor.	---
954C2: Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Ves-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
969B: Zell-----	Fair	Fair	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Fair.
Rothsay-----	Good	Good	Fair	Fair	Fair	---	Poor	Very poor.	Good	Fair	Poor	---
1013: Pits.												
1030: Udorthents.  Pits.												
1051: Glencoe-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Good	Good	Very poor.	Very poor.	Good	---
1106C: Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Ves-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
1107D: Sisseton-----	Very poor.	Very poor.	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Sioux-----	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
Heimdahl-----	Fair	Good	Good	Fair	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	---

## WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
1108: Harps-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
Glencoe-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
1222: Parle-----	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair.
1233B: Esmond-----	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Heimdal-----	Good	Good	Good	Good	---	Good	Very poor.	Very poor.	Good	---	Very poor.	---
1266C: Yellowbank-----	Very poor.	Poor	Good	Poor	Poor	---	Very poor.	Very poor.	Fair	Poor	Very poor.	Good.
Rock outcrop----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---
1295B: Doland-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
1296: Swenoda-----	Fair	Fair	Good	Good	Very poor.	---	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
1309C: Buse-----	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Doland-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
1865C: Buse-----	Very poor.	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Fair.
Barnes-----	Poor	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
1865F: Buse-----	Very poor.	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Fair.
1870: Burr-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
1938: Lakepark-----	Good	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair.

WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
1994: Emden-----	Fair	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Poor.

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# Engineering

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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.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

## Building Site Development

The table "Building Site Development" shows 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 *slight* if soil properties and site features generally are 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; and *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* 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* 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, large stones, 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* 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 generally are 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, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

*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, the available water capacity in the upper 40 inches, and the content of salts 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.

## Sanitary Facilities

The table "Sanitary Facilities" shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary

landfills. It also shows the suitability of the soils for use as a daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of *slight*, *moderate*, or *severe* are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of *good*, *fair*, and *poor* are given for daily cover for landfill.

A rating of *slight* or *good* indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of *moderate* or *fair* indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of *severe* or *poor* indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

*Septic tank absorption fields* are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, 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* 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, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively impervious soil material for the lagoon floor and sides is desirable to

minimize seepage and contamination of local ground water.

The table “Sanitary Facilities” gives ratings 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, 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 and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Trench sanitary landfill* is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

*Area sanitary landfill* is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in the table “Sanitary Facilities” are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, 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 affect trench type 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.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

## Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

## Construction Materials

The table “Construction Materials” 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.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In the table "Construction Materials," the 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 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.

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* are 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 one or more of the following characteristics: 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.

*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. In the table "Construction Materials," only the probability of finding material in suitable quantity in or below the soil 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 as much as 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. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*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 generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

## Water Management

The table "Water Management" gives 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 generally are 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; and *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 also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*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* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In the table "Water Management," the 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 more 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* 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* 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, 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, 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. Availability of drainage outlets is not considered in the ratings.

*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. The performance of a system is affected by the depth of the root zone, the amount of salts, and soil reaction.

*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 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* 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 affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

## BUILDING SITE DEVELOPMENT

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
31D2: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
34: Parnell-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
47: Colvin-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
51: La Prairie-----	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
60: Glyndon-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
67: Bearden-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
70: Svea-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
85: Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
108: McIntosh-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
113: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
114: Glencoe-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
127A: Sverdrup-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
127B: Sverdrup-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
127C: Sverdrup-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
137: Dovray-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
141A: Egeland-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
141B: Egeland-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
141C: Egeland-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
168B: Forman-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
184: Hamerly-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
210: Fulda-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
212A: Sinai-----	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
212B: Sinai-----	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
219: Rolfe-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
220D2: Langhei-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
236: Vallers-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
246: Marysland-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
276: Oldham-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
284B: Poinsett-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
288F: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
290B: Rothsay-----	Slight-----	Slight-----	Slight-----	Slight-----	Severe: frost action.	Slight.
293B: Swenoda-----	Slight-----	Slight-----	Moderate: shrink-swell.	Moderate: slope.	Moderate: frost action.	Slight.
314: Spottswood-----	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength.	Slight.
338: Waubay-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
339: Fordville-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
341A: Arvilla-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
341B: Arvilla-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
341C: Arvilla-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
344: Quam-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
347: Malachy-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
375: Forada-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
396D2: Sisseton-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
402F: Sioux-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty.
418: Lamoure-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
421B: Ves-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
423: Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
434: Perella-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
437F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
446: Normania-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
450: Rauville-----	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
494B: Darnen-----	Severe: excess humus.	Severe: low strength.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: frost action.	Slight.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
497: Hantho-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
509: Vallers-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
574: Du Page-----	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
597: Tara-----	Moderate: wetness.	Severe: low strength.	Moderate: wetness.	Severe: low strength.	Severe: frost action.	Slight.
610: Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
680: Parnell-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
694C2: Zell-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
706: Bigstone-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
724: Bigstone-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
741B: Poinsett-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Buse-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
748B: Hamlet-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
769A: Mehurin-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
769B: Mehurin-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
774: Svea-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
777C2: Sisseton-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Heimdal-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
883: Du Page-----	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Zumbro-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
891B: Doland-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Buse-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
902B: Barnes-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Buse-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
915C2: Buse-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Forman-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
942C2: Langhei-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
942C2: Barnes-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
954B: Ves-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Swanlake-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
954C2: Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Ves-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
969B: Zell-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: frost action.	Slight.
Rothsay-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: frost action.	Slight.
1013: Pits-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
1030: Udorthents.  Pits.						
1051: Glencoe-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
1106C: Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Hawick-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: too sandy.
Ves-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1107D: Sisseton-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Sioux-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Heimdal-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
1108: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Glencoe-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
1222: Parle-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1233B: Esmond-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
Heimdal-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
1266C: Yellowbank-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
1295B: Doland-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: low strength, frost action.	Slight.
1296: Swenoda-----	Moderate: wetness.	Slight-----	Moderate: wetness, shrink-swell.	Slight-----	Moderate: frost action.	Slight.
1309C: Buse-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.

## BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1309C: Doland-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
1865C: Buse-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Barnes-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength, frost action.	Moderate: large stones.
1865F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1870: Burr-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
1938: Lakepark-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
1994: Embden-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.

## SANITARY FACILITIES

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31D2: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
34: Parnell-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
47: Colvin-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
51: La Prairie-----	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Fair: too clayey.
60: Glyndon-----	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
67: Bearden-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.
70: Svea-----	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
85: Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
108: McIntosh-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
113: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114: Glencoe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
127A: Sverdrup-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
127B: Sverdrup-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
127C: Sverdrup-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
137: Dovray-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
141A: Egeland-----	Slight-----	Severe: seepage.	Moderate: too sandy.	Severe: seepage.	Poor: seepage.
141B: Egeland-----	Slight-----	Severe: seepage.	Moderate: too sandy.	Severe: seepage.	Poor: seepage.
141C: Egeland-----	Moderate: slope.	Severe: seepage, slope.	Moderate: slope, too sandy.	Severe: seepage.	Poor: seepage.
168B: Forman-----	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
184: Hamerly-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
210: Fulda-----	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
212A: Sinai-----	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
212B: Sinai-----	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
219: Rolfe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
220D2: Langhei-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
236: Vallers-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
246: Marysland-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
276: Oldham-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
284B: Poinsett-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
288F: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
290B: Rothsay-----	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
293B: Swenoda-----	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
314: Spottswood-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
338: Waubay-----	Severe: wetness.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
339: Fordville-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
341A: Arvilla-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
341B: Arvilla-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
341C: Arvilla-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
344: Quam-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
347: Malachy-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
375: Forada-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
396D2: Sisseton-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
402F: Sioux-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
418: Lamoure-----	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
421B: Ves-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
423: Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
434: Perella-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
437F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
446: Normania-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
450: Rauville-----	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, ponding.	Poor: hard to pack, ponding.
494B: Darnen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
497: Hantho-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
509: Vallers-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
574: Du Page-----	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding.	Good.
597: Tara-----	Severe: wetness.	Severe: wetness.	Moderate: wetness, too clayey.	Slight-----	Fair: too clayey, wetness.
610: Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
680: Parnell-----	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
694C2: Zell-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
706: Bigstone-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
724: Bigstone-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
741B: Poinsett-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
741B: Buse-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
748B: Hamlet-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
769A: Mehurin-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
769B: Mehurin-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
774: Svea-----	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
777C2: Sisseton-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Heimdal-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
883: Du Page-----	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding.	Good.
Zumbro-----	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: too sandy, thin layer.
891B: Doland-----	Moderate: percs slowly.	Moderate: seepage, slope, excess humus.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Buse-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
902B: Barnes-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
Buse-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
915C2: Buse-----	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Forman-----	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
942C2: Langhei-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Barnes-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
954B: Ves-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Swanlake-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
954C2: Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ves-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
969B: Zell-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
Rothsay-----	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
1013: Pits-----	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
1030: Udorthents.  Pits.					
1051: Glencoe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
1106C: Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1106C: Hawick-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Ves-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
1107D: Sisseton-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Sioux-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Heimdal-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
1108: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Glencoe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1222: Parle-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
1233B: Esmond-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
Heimdal-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
1266C: Yellowbank-----	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
1295B: Doland-----	Moderate: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.

## SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1296: Swenoda-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
1309C: Buse-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Doland-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
1865C: Buse-----	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
Barnes-----	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
1865F: Buse-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1870: Burr-----	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1938: Lakepark-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1994: Embden-----	Moderate: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Fair: too sandy.

## CONSTRUCTION MATERIALS

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
31D2: Storden-----	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
34: Parnell-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
47: Colvin-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
51: La Prairie-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
60: Glyndon-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
67: Bearden-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
70: Svea-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
85: Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
108: McIntosh-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
113: Webster-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
114: Glencoe-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
127A: Sverdrup-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
127B: Sverdrup-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
127C: Sverdrup-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
137: Dovray-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
141A: Egeland-----	Good-----	Improbable: thin layer.	Improbable: too sandy.	Fair: small stones.
141B: Egeland-----	Good-----	Improbable: thin layer.	Improbable: too sandy.	Fair: small stones.
141C: Egeland-----	Good-----	Improbable: thin layer.	Improbable: too sandy.	Fair: small stones, slope.
168B: Forman-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
184: Hamery-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
210: Fulda-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
212A: Sinai-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
212B: Sinai-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
219: Rolfe-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
220D2: Langhei-----	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
236: Vallers-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
246: Marysland-----	Fair: wetness.	Probable-----	Probable-----	Fair: small stones, area reclaim, thin layer.
276: Oldham-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
284B: Poinsett-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
288F: Esmond-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
290B: Rothsay-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
293B: Swenoda-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
314: Spottswood-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
338: Waubay-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
339: Fordville-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
341A: Arvilla-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
341B: Arvilla-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
341C: Arvilla-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
344: Quam-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
347: Malachy-----	Good-----	Probable-----	Improbable: too sandy.	Fair: small stones, thin layer.
375: Forada-----	Fair: wetness.	Probable-----	Probable-----	Poor: small stones.
396D2: Sisseton-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
402F: Sioux-----	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
418: Lamoure-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
421B: Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
423: Seaforth-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
434: Perella-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
437F: Buse-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
446: Normania-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
450: Rauville-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
494B: Darnen-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
497: Hantho-----	Fair: low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
509: Vallers-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
574: Du Page-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
597: Tara-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
610: Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
680: Parnell-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
694C2: Zell-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
706: Bigstone-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
724: Bigstone-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
741B: Poinsett-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Buse-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
748B: Hamlet-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
769A: Mehurin-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
769B: Mehurin-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
774: Svea-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
777C2: Sisseton-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
777C2: Heimdal-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
883: Du Page-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Zumbro-----	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy.
891B: Doland-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Buse-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
902B: Barnes-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Buse-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
915C2: Buse-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Forman-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
942C2: Langhei-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Barnes-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
954B: Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Swanlake-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
954C2: Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
969B: Zell-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Rothsay-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
1013: Pits-----	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
1030: Udorthents.  Pits.				
1051: Glencoe-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1106C: Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
1107D: Sisseton-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Sioux-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
Heimdal-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
1108: Harps-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
Glencoe-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Seaforth-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1222: Parle-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
1233B: Esmond-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Heimdahl-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1266C: Yellowbank-----	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Rock outcrop----	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock.
1295B: Doland-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1296: Swenoda-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1309C: Buse-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Doland-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
1865C: Buse-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Barnes-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, large stones.
1865F: Buse-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1870: Burr-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1938: Lakepark-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

## CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1994: Emden-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.

WATER MANAGEMENT

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
31D2: Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
34: Parnell-----	Slight-----	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.	
47: Colvin-----	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.	
51: La Prairie-----	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water--	Flooding-----	Favorable-----	Favorable.	
60: Glyndon-----	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Erodes easily, wetness.	Erodes easily.	
67: Bearden-----	Slight-----	Moderate: piping, hard to pack, wetness.	Severe: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Erodes easily, rooting depth.	
70: Svea-----	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
85: Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
108: McIntosh-----	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
113: Webster-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	

## WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
114: Glencoe-----	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
127A: Sverdrup-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
127B: Sverdrup-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
127C: Sverdrup-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.	
137: Dovray-----	Slight-----	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.	
141A: Egeland-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Droughty-----	Too sandy, soil blowing.	Droughty.	
141B: Egeland-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope, droughty.	Too sandy, soil blowing.	Droughty.	
141C: Egeland-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope-----	Slope, too sandy.	Slope.	
168B: Forman-----	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.	
184: Hamerly-----	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
210: Fulda	Slight	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.	
212A: Sinai	Slight	Severe: hard to pack.	Severe: slow refill.	Deep to water--	Percs slowly---	Erodes easily, percs slowly.	Erodes easily, percs slowly.	
212B: Sinai	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Deep to water--	Slope, slow intake, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.	
219: Rolfe	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.	
220D2: Langhei	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope-----	Slope.	
236: Vallers	Slight	Severe: piping, wetness.	Severe: slow refill.	Frost action--	Wetness-----	Wetness-----	Wetness.	
246: Marysland	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.	
276: Oldham	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.	
284B: Poinsett	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water--	Favorable-----	Erodes easily---	Erodes easily.	
288F: Esmond	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
290B: Rothsay	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water--	Favorable-----	Erodes easily---	Erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
293B: Swenoda-----	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
314: Spottswood-----	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Deep to water--	Favorable-----	Too sandy-----	Favorable.	
338: Waubay-----	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
339: Fordville-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water--	Rooting depth--	Too sandy-----	Rooting depth.	
341A: Arvilla-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
341B: Arvilla-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
341C: Arvilla-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.	
344: Quam-----	Slight-----	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Erodes easily, ponding.	Wetness, erodes easily.	
347: Malachy-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water--	Favorable-----	Too sandy-----	Favorable.	
375: Forada-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
396D2: Sisseton-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
402F: Sioux-----	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water--	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
418: Lamoure-----	Moderate: seepage.	Severe: hard to pack, wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.	
421B: Ves-----	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
423: Seaforth-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water--	Favorable-----	Favorable-----	Favorable.	
434: Perella-----	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Percs slowly, frost action.	Wetness, perc slowly.	Wetness-----	Percs slowly.	
437F: Buse-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
446: Normania-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
450: Rauville-----	Severe: seepage.	Severe: hard to pack, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding-----	Wetness.	
494B: Darnen-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Slope-----	Slope, wetness.	Erodes easily, wetness.	Erodes easily.	

## WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
497: Hantho-----	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
509: Vallers-----	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
574: Du Page-----	Severe: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water--	Flooding-----	Favorable-----	Favorable.	
597: Tara-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
610: Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
680: Parnell-----	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.	
694C2: Zell-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
706: Bigstone-----	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Erodes easily, ponding.	Wetness, erodes easily.	
724: Bigstone-----	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Erodes easily, ponding.	Wetness, erodes easily.	
741B: Poinsett-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
Buse-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
748B: Hamlet-----	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Deep to water--	Favorable-----	Favorable-----	Favorable.	
769A: Mehurin-----	Moderate: seepage.	Moderate: piping, wetness.	Severe: slow refill.	Percs slowly---	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.	
769B: Mehurin-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Severe: slow refill.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.	
774: Svea-----	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Deep to water--	Favorable-----	Erodes easily--	Erodes easily.	
777C2: Sisseton-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Heimdal-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope, rooting depth.	Slope-----	Slope, rooting depth.	
883: Du Page-----	Severe: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water--	Flooding-----	Favorable-----	Favorable.	
Zumbro-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Soil blowing---	Too sandy, soil blowing.	Favorable.	
891B: Doland-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Favorable-----	Favorable.	
Buse-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
902B: Barnes-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
902B: Buse-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
915C2: Buse-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Forman-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope, percs slowly.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.	
942C2: Langhei-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope-----	Slope.	
Barnes-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
954B: Ves-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
Swanlake-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
954C2: Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Ves-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
969B: Zell-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
Rothsay-----	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
1013: Pits-----	Severe: depth to rock, slope.	Slight-----	Severe: no water.	Deep to water--	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.	

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
1030: Udorthents. Pits.								
1051: Glencoe	Moderate: seepage.	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.	
1106C: Storden	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.	
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
Ves	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.	
1107D: Sisseton	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.	
Sioux	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
Heimdal	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.	
1108: Harps	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness	Wetness.	
Glencoe	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.	
Seaforth	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable	Favorable.	
1222: Parle	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
1233B: Esmond-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
Heimdal-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope, rooting depth.	Favorable-----	Rooting depth.	
1266C: Yellowbank-----	Severe: depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.	
Rock outcrop----	Severe: depth to rock.	Slight-----	Severe: no water.	Deep to water--	Depth to rock--	Depth to rock--	Depth to rock.	
1295B: Doland-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water--	Slope-----	Favorable-----	Favorable.	
1296: Swenoda-----	Severe: seepage.	Severe: piping.	Severe: no water.	Favorable-----	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.	
1309C: Buse-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Doland-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope-----	Slope.	
1865C: Buse-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
Barnes-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Erodes easily--	Erodes easily.	
1865F: Buse-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water--	Slope-----	Slope, erodes easily.	Slope, erodes easily.	

WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
1870: Burr-----	Slight-----	Severe: wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.	
Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
1938: Lakepark-----	Slight-----	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
1994: Embsden-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water--	Soil blowing---	Soil blowing---	Favorable.	

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# Soil Properties

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Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

The table "Engineering Index Properties" gives estimates of the engineering classification and of the range of index properties 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 in the series descriptions in Part I of this survey.

*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 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the system adopted by the Unified soil classification system (ASTM, 1993) and the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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, SP-SM.

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 oven-dry 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 in the table.

## Physical and Chemical Properties

The tables "Physical Properties of the Soils" and "Chemical Properties of the Soils" show estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*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 in the series descriptions in Part I of this survey.

*Clay* as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at  $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In the table "Physical Properties of the Soils," the estimated moist bulk

density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone.

The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In the table "Physical Properties of the Soils," the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

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

*Erosion factor T* is an estimate of the maximum average 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.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams that have more than 5 percent finely divided calcium carbonate. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils have less than 5 percent finely divided calcium carbonate. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils have less than 5 percent finely divided calcium carbonate. These soils are moderately erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils have less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

In the table "Chemical Properties of the Soils," *cation-exchange capacity* is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. It is a measurement of the nutrient-holding capacity of the soil.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Calcium carbonate* is expressed as a weighted percentage of the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients, such as phosphorus, is affected by the amount of carbonates in the soil.

*Salinity* is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil

for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

## Water Features

The table "Water Features" gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

*Hydrologic soil groups* are groups of soils that, when saturated, have the same runoff potential under similar storm and ground cover conditions. The soil properties that affect the runoff potential are those that influence the minimum rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of very 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 a moderately fine 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 that have a moderately fine 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 clayey soils that have a high shrink-swell potential, soils that have a permanent 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 in the table, the first letter is for drained areas and the second is for undrained areas.

*Flooding*, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

The table "Water Features" gives the frequency and duration of flooding and the time of year when flooding is most likely to occur. Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as none, rare, occasional, or frequent. *None* means flooding is not probable; *rare* that it is unlikely but is possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 to 30 days), and *very long* (more than 30 days). The time of year that flooding is most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding 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 level 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 a zone of saturation at the highest average depth during the wettest season. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Indicated in the table "Water Features" are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An *apparent* water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time for adjustments in the surrounding soil.

A *perched* water table is one that is above an unsaturated zone in the soil. The basis for determining that a water table is perched may be general knowledge of the area. The water table is proven to be perched if the water level in a borehole is observed to fall when the borehole is extended.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

## Soil Features

The table “Soil Features” gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

*Depth to bedrock* is given if bedrock is within a depth of 60 inches. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as 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.

*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.

A *low* potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a *moderate* potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a *high* potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

*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 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.

## ENGINEERING INDEX PROPERTIES

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
31D2: Storden-----	0-5	Loam-----	CL	A-6	0	0-5	95-100	95-98	70-85	55-70	28-36	9-15
	5-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-85	55-70	28-39	9-18
34: Parnell-----	0-18	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	18-38	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	0	100	95-100	90-100	70-100	40-80	20-50
	38-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	0	95-100	90-100	80-95	70-95	30-80	15-50
47: Colvin-----	0-10	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	35-50	15-30
	10-25	Silt loam, silty clay loam.	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	25-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
51: La Prairie-----	0-9	Loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	85-95	70-80	25-40	5-15
	9-38	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	0	100	100	85-100	50-90	25-50	5-25
	38-50	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	0	100	100	85-100	70-90	25-50	5-25
	50-60	Stratified fine sandy loam to silty clay loam.	CL-ML, CL, SC, SC-SM	A-4, A-6, A-7	0	0	100	95-100	75-100	45-90	25-50	5-25
60: Glyndon-----	0-10	Silt loam-----	ML	A-4	0	0	100	100	95-100	70-95	20-40	NP-10
	10-18	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	0	100	100	90-100	85-95	20-30	NP-10
	18-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, SM, SC, CL	A-4	0	0	100	100	85-100	35-75	10-30	NP-10
67: Bearden-----	0-11	Silty clay loam	CL, CH	A-6, A-7	0	0	100	100	95-100	80-95	25-55	10-30
	11-46	Silt loam, silty clay loam, loam.	CL, CH	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	46-60	Silt loam, silty clay loam, loam.	CL, CH	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
70: Svea-----	0-10	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-100	80-95	60-90	20-40	5-20
	10-26	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	26-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-95	60-85	20-50	5-30
85: Calco-----	0-10	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	10-55	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	55-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	0	100	100	90-100	80-100	30-45	10-20
108: McIntosh-----	0-9	Silt loam-----	CL, ML	A-4, A-6	0	0	100	100	85-100	70-95	28-36	9-15
	9-30	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	28-43	9-21
	30-60	Loam, clay loam	CL, ML	A-6, A-4	0	0-5	95-100	90-100	80-95	60-80	28-43	9-21
113: Webster-----	0-17	Clay loam-----	CL, CH	A-7, A-6	0	0-5	95-100	95-100	85-95	70-90	35-60	15-30
	17-50	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	50-60	Loam, sandy loam, clay loam.	CL	A-6	0	0-5	95-100	90-100	75-85	50-75	30-40	10-20
114: Glencoe-----	0-12	Silty clay loam	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	35-45	15-20
	12-40	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	40-55	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	55-60	Loam, clay loam	CL, ML	A-6	0	0	90-100	85-100	60-95	55-75	30-40	10-20
127A: Sverdrup-----	0-9	Sandy loam-----	SM	A-4	0	0	100	95-100	60-70	35-50	20-30	NP-10
	9-43	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	0	100	95-100	50-75	30-70	0-30	NP-5
	43-60	Sand, fine sand	SP, SP-SM	A-3, A-2	0	0	100	93-100	50-90	2-10	0-20	NP-5
127B: Sverdrup-----	0-12	Sandy loam-----	SM	A-4	0	0	100	95-100	60-70	35-50	20-30	NP-10
	12-21	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	0	100	95-100	50-75	30-70	0-30	NP-5
	21-60	Sand, fine sand	SP, SP-SM	A-3, A-2	0	0	100	93-100	50-90	2-10	0-20	NP-5

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
127C: Sverdrup-----	0-10	Sandy loam-----	SM	A-4	0	0	100	95-100	60-70	35-50	20-30	NP-10
	10-15	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	0	100	95-100	50-75	30-70	0-30	NP-5
	15-60	Sand, fine sand	SP, SP-SM	A-3, A-2	0	0	100	93-100	50-90	2-10	0-20	NP-5
137: Dovray-----	0-10	Silty clay-----	CH, MH, OH	A-7	0	0	100	100	95-100	85-95	56-76	33-49
	10-25	Clay, silty clay.	CH, MH	A-7	0	0	100	100	95-100	85-95	56-76	33-49
	25-47	Clay, silty clay.	CH, MH	A-7	0	0	100	100	90-100	85-95	56-76	33-49
	47-60	Clay, silty clay loam, clay loam.	CH, MH, CL	A-7	0	0	100	100	80-100	70-95	41-76	21-49
141A: Egeland-----	0-9	Sandy loam-----	SM, SC-SM	A-2, A-4	0	0	100	95-100	75-100	30-50	15-25	NP-7
	9-50	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	15-50	15-25	NP-7
	50-60	Loamy sand, loamy fine sand, loamy very fine sand.	SM, SP-SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	10-45	15-25	NP-5
141B: Egeland-----	0-13	Sandy loam-----	SM, SC-SM	A-2, A-4	0	0	100	95-100	75-100	30-50	15-25	NP-7
	13-45	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	15-50	15-25	NP-7
	45-60	Loamy sand, loamy fine sand, loamy very fine sand.	SM, SP-SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	10-45	15-25	NP-5
141C: Egeland-----	0-11	Loam-----	CL, CL-ML	A-4, A-6	0	0	100	100	85-100	50-80	25-40	5-15
	11-25	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	15-50	15-25	NP-7
	25-60	Loamy sand, loamy fine sand, loamy very fine sand.	SM, SP-SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	10-45	15-25	NP-5

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
168B: Forman-----	0-9	Clay loam-----	CL	A-6, A-7	0	0-5	95-100	90-100	85-100	70-80	30-45	10-25
	9-25	Clay loam-----	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	25-45	5-20
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	25-45	5-20
184: Hamerly-----	0-9	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-29	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-95	80-95	60-75	20-40	5-20
	29-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-95	80-95	60-75	20-40	5-20
210: Fulda-----	0-13	Silty clay-----	CH, CL	A-7	0	0	100	100	95-100	85-95	40-70	20-35
	13-28	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	0	100	100	90-100	90-95	45-70	25-50
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	85-95	40-70	15-30
212A: Sinai-----	0-10	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	90-100	43-56	22-33
	10-17	Silty clay, silty clay loam, clay.	CH	A-7	0	0	100	100	95-100	90-100	51-76	29-49
	17-34	Silty clay, silty clay loam, clay.	CH	A-7	0	0	100	100	95-100	90-100	51-76	29-49
	34-60	Stratified silty clay to silt loam.	CL, CH	A-7	0	0	100	100	95-100	80-95	45-70	25-50
212B: Sinai-----	0-10	Silty clay-----	CL, CH, MH, ML	A-7	0	0	100	100	95-100	90-100	45-70	20-35
	10-19	Silty clay, clay.	CH, MH	A-7	0	0	100	100	95-100	90-100	60-90	25-55
	19-45	Silty clay, clay.	CH, MH	A-7	0	0	100	100	95-100	90-100	60-90	25-55
	45-60	Stratified silty clay to silt loam.	CL, CH	A-7	0	0	100	100	95-100	80-95	40-65	15-35
219: Rolfe-----	0-22	Silt loam-----	OL, CL, ML	A-6, A-4	0	0	100	95-100	90-100	80-95	30-40	5-15
	22-34	Clay, silty clay, clay loam.	CH	A-7	0	0	100	95-100	90-100	75-95	50-65	25-35
	34-60	Clay loam, loam	CL	A-7, A-6	0	0	95-100	90-100	80-90	55-75	30-45	10-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
220D2: Langhei-----	0-6	Loam-----	CL-ML, CL	A-4, A-6	0	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	6-16	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	16-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
236: Vallers-----	0-15	Clay loam-----	OL, CL, ML	A-6, A-7	0	0	95-100	95-100	95-100	85-95	30-50	11-20
	15-30	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	0	0	95-100	90-100	80-95	50-80	30-40	11-20
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-95	60-85	20-40	5-20
246: Marysland-----	0-17	Loam-----	CL	A-6, A-7	0	0	95-100	95-100	85-95	50-80	30-50	10-25
	17-25	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	0	90-100	85-100	80-95	45-80	20-40	10-20
	25-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	0	70-95	50-90	35-70	5-20	0-14	NP
276: Oldham-----	0-17	Silty clay-----	CL, CH, MH, ML	A-7	0	0	100	95-100	90-100	85-100	40-60	15-25
	17-55	Silty clay loam, clay loam, silty clay.	CL, CH, MH, ML	A-7	0	0	100	95-100	85-100	85-100	40-60	15-25
	55-60	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0	100	95-100	85-100	70-100	25-45	5-20
284B: Poinsett-----	0-12	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	12-20	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	95-100	95-100	75-100	30-50	10-25
	20-26	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	95-100	95-100	75-100	30-50	10-25
	26-60	Clay loam-----	CL	A-6, A-7	0	0	95-100	90-100	80-100	65-85	30-50	10-30
288F: Esmond-----	0-7	Loam-----	ML	A-4	0	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-60	Loam, sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0	0-5	90-100	85-100	60-100	35-90	20-40	NP-15

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
290B: Rothsay-----	0-10	Silt loam-----	ML	A-4	0	0	95-100	95-100	90-100	85-100	20-40	NP-10
	10-25	Silt loam, very fine sandy loam, loam.	ML	A-4	0	0	95-100	95-100	90-100	80-100	20-40	NP-10
	25-60	Silt loam, loam, very fine sandy loam.	ML	A-4	0	0	95-100	95-100	90-100	80-90	10-28	NP-10
293B: Swenoda-----	0-10	Loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	85-95	50-80	25-40	5-15
	10-25	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	0	100	95-100	60-100	30-60	15-30	NP-10
	25-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	20-50	5-30
314: Spottswood-----	0-8	Loam-----	CL, CL-ML	A-6, A-4	0	0	95-100	95-100	90-100	65-90	25-40	5-15
	8-32	Clay loam, loam	CL	A-6, A-7	0	0	95-100	95-100	85-100	55-80	30-45	10-20
	32-60	Gravelly sand, loamy sand, gravelly loamy sand.	SM, GM, SP-SM, GP-GM	A-1, A-2	0	0-5	40-80	25-75	15-70	10-30	15-20	NP-4
338: Waubay-----	0-12	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	12-16	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	16-34	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	0	100	100	95-100	85-100	30-45	5-20
	34-60	Silt loam, loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	0	100	100	90-100	70-95	30-45	5-20
339: Fordville-----	0-9	Loam-----	ML, CL	A-4, A-6, A-7	0	0	100	100	70-85	55-75	30-45	5-20
	9-16	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	0	100	95-100	70-95	55-80	30-45	5-20
	16-21	Loam, clay loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0	0	95-100	90-100	65-90	40-55	25-40	3-15
	21-60	Gravelly loamy sand, gravelly sand, very gravelly sand.	SW, SW-SM, SM	A-1	0	0	65-85	45-70	15-45	0-15	15-25	NP-5

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
341A: Arvilla-----	0-9	Sandy loam-----	SM, SC, SC-SM	A-2, A-4, A-6	0	0	95-100	90-100	50-80	20-45	0-30	NP-15
	9-23	Sandy loam, loam, coarse sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0	0	90-100	85-100	50-80	20-45	0-40	NP-15
	23-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SM, GP-GM	A-1, A-2, A-3	0	0	35-100	25-100	10-60	0-15	0-14	NP
341B: Arvilla-----	0-10	Sandy loam-----	SM, SC, SC-SM	A-2, A-4, A-6	0	0	95-100	90-100	50-80	20-45	0-30	NP-15
	10-13	Sandy loam, loam, coarse sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0	0	90-100	85-100	50-80	20-45	0-40	NP-15
	13-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SM, GP-GM	A-1, A-2, A-3	0	0	35-100	25-100	10-60	0-15	0-14	NP
341C: Arvilla-----	0-9	Sandy loam-----	SM, SC, SC-SM	A-2, A-4, A-6	0	0	95-100	90-100	50-80	20-45	0-30	NP-15
	9-14	Sandy loam, loam, coarse sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0	0	90-100	85-100	50-80	20-45	0-40	NP-15
	14-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SM, GP-GM	A-1, A-2, A-3	0	0	35-100	25-100	10-60	0-15	0-14	NP
344: Quam-----	0-9	Silty clay loam	CL, ML, OL	A-7	0	0	100	100	90-100	85-95	40-50	15-25
	9-54	Silty clay loam, silt loam, loam.	CL, ML	A-7, A-6, A-4	0	0	100	100	80-100	70-95	30-50	5-25
	54-60	Clay loam, silty clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	0	100	90-100	85-95	70-90	20-50	5-20
347: Malachy-----	0-18	Loam-----	ML, CL	A-4	0	0	100	90-100	80-95	50-75	21-32	4-13
	18-30	Loam, fine sandy loam, sandy loam.	SM, ML, SC, CL	A-4	0	0	100	80-100	60-95	35-75	15-28	NP-10
	30-60	Gravelly clay, loamy fine sand, sand.	SM, SP-SM	A-1, A-2, A-3	0	0	85-100	75-100	30-80	5-35	---	NP

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
375: Forada-----	0-21	Loam-----	ML	A-4	0	0	95-100	85-100	70-90	50-70	25-35	5-20
	21-35	Sandy loam, loam, fine sandy loam.	ML, SM	A-4, A-2	0	0	95-100	85-100	55-85	30-60	15-30	NP-10
	35-60	Sand, gravelly coarse sand, loamy sand.	SP, SM, SP-SM, GP-GM	A-1, A-2, A-3	0	0	50-100	50-100	40-70	5-30	---	NP
396D2: Sisseton-----	0-6	Loam-----	ML, CL	A-4, A-6	0	0-5	95-100	90-100	90-100	60-75	30-40	5-15
	6-18	Loam, silt loam	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-100	60-90	20-40	3-15
	18-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	70-95	50-75	20-35	NP-15
402F: Sioux-----	0-7	Gravelly loam	SM, GM	A-4, A-2	0	0-5	60-90	50-80	45-70	25-50	20-35	NP-7
	7-10	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, GM	A-4, A-2, A-1	0	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	10-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	0-5	25-75	20-60	5-35	0-25	0-25	NP-5
418: Lamoure-----	0-9	Silty clay loam	CL, CH, MH, ML	A-7	0	0	100	100	95-100	85-100	40-70	15-35
	9-55	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7	0	0	100	100	90-100	60-100	40-70	15-35
	55-60	Silty clay loam, silt loam, loam.	CL, ML	A-6, A-7	0	0	95-100	95-100	90-100	60-100	30-70	10-35
421B: Ves-----	0-10	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	10-25	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	25-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
423: Seaforth-----	0-9	Loam-----	ML, CL	A-6	0	0-5	95-100	90-97	80-95	60-80	30-38	11-18
	9-21	Loam, clay loam	CL	A-6	0	0-5	90-100	90-97	80-95	55-80	30-39	11-18
	21-60	Loam-----	CL	A-6	0	0-5	90-100	90-95	80-90	55-80	30-36	11-15
434: Perella-----	0-16	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	95-100	95-100	85-95	25-50	5-30
	16-25	Silt loam, silty clay loam, silty clay.	CL, CL-ML, CH	A-4, A-7, A-6	0	0	100	95-100	95-100	80-100	25-60	5-40
	25-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-7, A-6	0	0	100	95-100	95-100	80-100	25-45	5-25

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
437F: Buse-----	0-7	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	7-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
446: Normania-----	0-14	Clay loam-----	CL	A-6	0	0-5	95-100	90-95	80-90	60-80	36-41	16-20
	14-23	Loam, clay loam	CL	A-6	0	0-5	95-100	90-95	80-95	55-85	32-41	13-20
	23-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-95	80-90	55-80	32-41	13-20
450: Rauville-----	0-42	Silty clay loam	CL, CH, MH	A-6, A-7	0	0	100	100	90-100	85-100	35-60	15-28
	42-60	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	0	100	100	90-100	85-100	35-60	15-28
494B: Darnen-----	0-26	Loam-----	OL, ML, CL, CL-ML	A-4	0	0	100	100	85-100	60-90	20-35	2-10
	26-44	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	85-100	60-90	20-45	5-25
	44-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	90-100	90-100	80-95	60-85	20-45	5-25
497: Hantho-----	0-10	Silt loam-----	ML	A-4, A-6	0	0	100	98-100	90-100	85-100	21-36	4-15
	10-22	Silt loam, very fine sandy loam.	ML, CL-ML	A-4	0	0	100	98-100	90-100	80-100	21-36	4-9
	22-60	Silt loam, very fine sandy loam.	ML, CL-ML	A-4	0	0	100	98-100	90-100	80-100	21-36	4-9
509: Vallers-----	0-13	Clay loam-----	OL, CL, ML	A-6, A-7	0	0	95-100	95-100	95-100	85-95	30-50	11-20
	13-19	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	0	0	95-100	90-100	80-95	50-80	30-40	11-20
	19-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-95	60-85	20-40	5-20
574: Du Page-----	0-46	Loam-----	CL	A-6, A-7	0	0	95-100	95-100	90-100	70-95	30-45	11-21
	46-60	Sandy loam, loam, gravelly sandy clay loam.	CL	A-4, A-6, A-7	0	0	85-100	75-100	65-100	55-95	25-45	7-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
597: Tara-----	0-10	Silt loam-----	OL, ML	A-4, A-6	0	0	100	100	90-100	70-90	30-40	2-12
	10-25	Silt loam, loam	ML, CL-ML	A-4, A-6	0	0	100	100	85-100	80-90	20-40	2-12
	25-36	Loam, silt loam	CL-ML, ML	A-6, A-4	0	0	100	95-100	85-95	80-90	20-40	2-12
	36-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-2	95-100	85-95	80-90	55-80	20-40	6-20
610: Calco-----	0-41	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	41-46	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	46-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	0	100	100	90-100	80-100	30-45	10-20
680: Parnell-----	0-17	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	17-39	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	0-2	97-100	95-100	90-100	70-100	40-80	20-50
	39-60	Clay loam, silty clay loam, loam.	CL, CH	A-6, A-7	0	0-2	95-100	92-100	80-95	70-95	35-60	15-40
694C2: Zell-----	0-7	Silt loam-----	CL, ML	A-4, A-6	0	0	100	95-100	90-100	80-100	30-40	5-15
	7-11	Silt loam, very fine sandy loam, loam.	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	70-100	25-40	5-15
	11-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML	A-4	0	0	100	95-100	85-100	60-100	15-25	NP-7
706: Bigstone-----	0-11	Silty clay loam	CL, ML, OL	A-7	0	0	100	100	80-100	80-100	37-43	15-21
	11-30	Silty clay loam, silt loam.	CL, ML	A-7, A-6	0	0	100	95-98	90-98	75-90	30-43	11-21
	30-60	Clay loam, loam	CL, ML	A-7, A-6	0	0	100	90-98	70-90	60-80	30-41	11-20
724: Bigstone-----	0-9	Silty clay loam	CL, ML, OL	A-7	0	0	100	100	80-100	80-100	37-43	15-21
	9-54	Silty clay loam, silt loam.	CL, ML	A-7, A-6	0	0	100	95-98	90-98	75-90	30-43	11-21
	54-60	Clay loam, loam	CL, ML	A-7, A-6	0	0	100	90-98	70-90	60-80	30-41	11-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
741B: Poinsett-----	0-9	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	9-17	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	95-100	95-100	75-100	30-50	10-25
	17-60	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	95-100	95-100	75-100	30-50	10-25
Buse-----	0-9	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	9-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
748B: Hamlet-----	0-10	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	85-95	60-75	20-40	5-25
	10-38	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	0-5	95-100	90-100	85-100	60-80	25-45	5-25
	38-60	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	0-5	95-100	90-100	85-100	60-80	25-45	5-25
769A: Mehurin-----	0-9	Clay loam-----	CL	A-6, A-7	0	0-4	95-100	90-98	50-90	50-80	35-40	15-20
	9-14	Clay loam, silty clay, clay.	CL, CH, MH	A-7	0	0-4	95-100	90-98	50-90	50-90	45-65	20-40
	14-21	Clay loam, loam	CL	A-6, A-7	0	0-4	95-100	90-98	45-90	45-80	30-45	10-20
	21-60	Clay loam, loam	CL	A-6, A-7	0	0-4	95-100	90-98	45-90	45-80	30-45	10-20
769B: Mehurin-----	0-8	Clay loam-----	CL	A-6, A-7	0	0-4	95-100	90-98	50-90	50-80	35-40	15-20
	8-17	Clay loam, silty clay, clay.	CL, CH, MH	A-7	0	0-4	95-100	90-98	50-90	50-90	45-65	20-40
	17-30	Clay loam, loam	CL	A-6, A-7	0	0-4	95-100	90-98	45-90	45-80	30-45	10-20
	30-60	Clay loam, loam	CL	A-6, A-7	0	0-4	95-100	90-98	45-90	45-80	30-45	10-20
774: Svea-----	0-10	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-100	80-95	60-90	20-40	5-20
	10-23	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	23-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-95	60-85	20-50	5-30

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
777C2: Sisseton-----	0-6	Loam-----	ML, CL	A-4, A-6	0	0-5	95-100	90-100	90-100	60-75	30-40	5-15
	6-24	Loam, silt loam	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-100	60-90	20-40	3-15
	24-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	70-95	50-75	20-35	NP-15
Heimdal-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	8-26	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	26-47	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	47-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-3	95-100	85-95	50-80	35-65	15-30	2-12
883: Du Page-----	0-38	Loam-----	CL	A-6, A-7	0	0	95-100	95-100	90-100	70-95	30-45	11-21
	38-60	Sandy loam, loam, gravelly sandy clay loam.	CL	A-4, A-6, A-7	0	0	85-100	75-100	65-100	55-95	25-45	7-20
Zumbro-----	0-9	Sandy loam-----	SM	A-4	0	0	100	95-100	70-95	35-50	15-28	NP
	9-32	Loamy sand, loamy fine sand.	SM	A-2	0	0	100	95-100	60-95	15-30	10-21	NP
	32-47	Sand, fine sand, loamy sand.	SP, SM, SP-SM	A-2, A-3	0	0	95-100	85-100	60-95	4-30	---	NP
	47-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	0	90-100	80-100	50-80	4-20	---	NP
891B: Doland-----	0-10	Silt loam-----	OL, ML	A-4, A-6	0	0	100	100	90-100	70-90	30-40	2-12
	10-28	Silt loam, loam	ML, CL-ML	A-4, A-6	0	0	100	100	85-100	60-90	20-40	2-12
	28-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0	0	90-100	85-98	80-90	55-80	20-40	6-20
Buse-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	8-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
902B: Barnes-----	0-10	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	10-21	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	21-60	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-40	5-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
902B: Buse-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	8-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
915C2: Buse-----	0-7	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	0	90-100	85-100	70-90	55-85	25-45	5-20
Forman-----	0-9	Clay loam-----	CL	A-6, A-7	0	0-5	95-100	90-100	85-100	70-80	30-45	10-25
	9-15	Clay loam-----	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	25-45	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	25-45	5-20
942C2: Langhei-----	0-5	Loam-----	CL-ML, CL	A-4, A-6	0	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	5-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
Barnes-----	0-9	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	9-32	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	32-60	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-40	5-20
954B: Ves-----	0-9	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	9-21	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	21-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
Swanlake-----	0-8	Loam-----	CL, ML	A-6	0	0-5	90-100	85-98	75-90	50-70	28-36	9-15
	8-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-90	50-70	28-39	9-18
954C2: Storden-----	0-5	Loam-----	CL	A-6	0	0-5	95-100	95-98	70-85	55-70	28-36	9-15
	5-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-85	55-70	28-39	9-18
Ves-----	0-8	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	8-22	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	22-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
969B: Zell-----	0-9	Silt loam-----	CL, ML	A-4, A-6	0	0	100	95-100	90-100	80-100	30-40	5-15
	9-21	Silt loam, very fine sandy loam, loam.	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	70-100	25-40	5-15
	21-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML	A-4	0	0	100	95-100	85-100	60-100	15-25	NP-7
Rothsay-----	0-9	Silt loam-----	ML	A-4	0	0	95-100	95-100	90-100	85-100	20-40	NP-10
	9-23	Silt loam, very fine sandy loam, loam.	ML	A-4	0	0	95-100	95-100	90-100	80-100	20-40	NP-10
	23-60	Silt loam, loam, very fine sandy loam.	ML	A-4	0	0	95-100	95-100	90-100	80-90	10-28	NP-10
1013: Pits-----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
1030: Udorthents.  Pits.												
1051: Glencoe-----	0-45	Silty clay loam	OL, OH, MH, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-55	10-25
	45-57	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-50	10-25
	57-60	Loam, clay loam	CL, ML	A-6, A-7	0	0	90-100	85-100	60-95	55-75	30-50	10-20
1106C: Storden-----	0-5	Loam-----	CL	A-6	0	0-5	95-100	95-98	70-85	55-70	28-36	9-15
	5-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-85	55-70	28-39	9-18
Hawick-----	0-9	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	9-20	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	20-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
Ves-----	0-8	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	8-23	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	23-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
1107D: Sisseton-----	0-5	Loam-----	ML, CL	A-4, A-6	0	0-5	95-100	90-100	90-100	60-75	30-40	5-15
	5-31	Loam, silt loam	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-100	60-90	20-40	3-15
	31-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	70-95	50-75	20-35	NP-15
Sioux-----	0-7	Gravelly loam	SM, GM	A-4, A-2	0	0-5	60-90	50-80	45-70	25-50	20-35	NP-7
	7-29	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, GM	A-4, A-2, A-1	0	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	29-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	0-5	25-75	20-60	5-35	0-25	0-25	NP-5
Heimdal-----	0-7	Loam-----	ML, CL, CL-ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	7-21	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	21-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	2-12
1108: Harps-----	0-16	Loam-----	CL	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	30-45	10-25
	16-38	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	38-60	Loam, sandy clay loam, clay loam.	CL	A-6	0	0-5	95-100	90-100	70-80	50-75	25-40	10-25
Glencoe-----	0-10	Silty clay loam	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	35-45	15-20
	10-30	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	30-57	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	57-60	Loam, clay loam	CL, ML	A-6	0	0	90-100	85-100	60-95	55-75	30-40	10-20
Seaforth-----	0-9	Clay loam-----	ML, CL	A-6	0	0-5	95-100	90-97	80-95	60-80	30-38	11-18
	9-30	Loam, clay loam	CL	A-6	0	0-5	90-100	90-97	80-95	55-80	30-39	11-18
	30-60	Loam-----	CL	A-6	0	0-5	90-100	90-95	80-90	55-80	30-36	11-15

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
1222: Parle-----	0-9	Clay loam-----	CL	A-6, A-7	0	0	100	98-100	90-100	70-80	36-48	15-25
	9-26	Loam, clay loam, silt loam.	CL-ML, CL, ML	A-6, A-7	0	0	100	98-100	85-100	70-85	21-43	4-21
	26-34	Loam, clay loam, silty clay loam.	CL-ML, CL, ML	A-6, A-7	0	0	100	98-100	75-100	70-85	21-43	4-21
	34-50	Silty clay loam, clay loam, silt loam.	CL-ML, CL	A-4, A-6, A-7	0	0	100	98-100	80-100	70-95	23-43	6-21
	50-60	Loamy sand, loamy fine sand, sandy loam.	SP-SM	A-2, A-3, A-4	0	0	100	93-100	60-75	30-40	10-25	NP-7
1233B: Esmond-----	0-9	Loam-----	ML	A-4	0	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	9-60	Loam, sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
Heimdal-----	0-9	Loam-----	ML, CL, CL-ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	9-25	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	25-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	2-12
1266C: Yellowbank-----	0-12	Loam-----	CL, ML	A-4, A-6	0	0	90-100	80-100	65-95	50-75	21-36	4-15
	12-16	Loam, silt loam, sandy loam.	SM, ML	A-2-4, A-4, A-6	0	0-5	90-100	80-100	45-95	25-90	10-30	NP-11
	16-26	Unweathered bedrock.			0	0	0	0	0	0	---	NP
Rock outcrop----	0-60	Unweathered bedrock.			---	---	---	---	---	---	---	---
1295B: Doland-----	0-8	Silt loam-----	ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	28-36	9-15
	8-23	Silt loam, loam	ML, CL	A-4, A-6	0	0	100	100	85-100	60-90	28-39	9-18
	23-42	Loam, clay loam	CL, ML	A-4, A-6	0	0-5	90-100	85-100	80-90	55-80	28-39	9-18
	42-60	Loam, clay loam	CL, ML	A-4, A-6	0	0-5	90-100	85-98	80-90	55-80	28-39	9-18

## ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
					Pct	Pct					Pct	
1296: Swenoda-----	0-16	Sandy loam-----	SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	NP-7
	16-21	Fine sandy loam, sandy loam.	SC-SM, SM, ML, CL-ML	A-2, A-4	0	0	100	95-100	60-100	30-55	15-30	NP-10
	21-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	25-50	5-30
1309C: Buse-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	8-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
Doland-----	0-9	Silt loam-----	OL, ML	A-4, A-6	0	0	100	100	90-100	70-90	30-40	2-12
	9-18	Silt loam, loam	ML, CL-ML	A-4, A-6	0	0	100	100	85-100	60-90	20-40	2-12
	18-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0	0	90-100	85-98	80-90	55-80	20-40	6-20
1865C: Buse-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	8-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
Barnes-----	0-15	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	15-22	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	22-60	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-40	5-20
1865F: Buse-----	0-7	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	55-80	20-40	3-15
	7-60	Loam-----	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	70-90	60-80	25-40	5-15
1870: Burr-----	0-9	Silty clay loam	CL	A-7	0	0	100	95-100	85-95	75-90	39-48	15-30
	9-45	Silty clay loam, silty clay.	CL, CH	A-7	0	0	100	90-100	80-95	75-90	43-52	21-28
	45-60	Stratified silt loam to clay.	CL, CH	A-7, A-6	0	0	100	95-100	80-95	65-90	36-52	15-28
Calco-----	0-30	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	30-51	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	51-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	0	100	100	90-100	80-100	30-45	10-20

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
1938: Lakepark-----	0-10	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	100	95-100	90-100	65-90	20-40	2-15
	10-26	Clay loam, silty clay loam, silt loam.	ML, CL	A-4, A-6	0	0	100	95-100	90-100	65-90	30-40	2-12
	26-37	Silty clay loam, clay loam, loam.	CL	A-6, A-7	0	0-5	95-100	95-100	85-100	65-90	30-45	15-30
	37-60	Clay loam, loam	CL	A-6	0	0-5	95-100	90-100	75-85	55-75	30-40	10-20
1994: Emden-----	0-17	Sandy loam-----	SM, ML	A-2, A-4	0	0	100	100	60-95	30-65	0-35	NP-10
	17-60	Fine sandy loam, sandy loam.	SM, ML	A-2, A-4	0	0	100	100	60-85	30-50	0-14	NP

## PHYSICAL PROPERTIES OF THE SOILS

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
31D2: Storden-----	0-5	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L
	5-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
34: Parnell-----	0-18	27-40	1.20-1.30	0.20-0.60	0.18-0.22	Moderate	6.0-10	0.28	0.28	5	7
	18-38	35-60	1.20-1.30	0.06-0.20	0.13-0.19	High-----	---	0.28	0.28		
	38-60	35-45	1.20-1.40	0.06-0.20	0.11-0.19	High-----	---	0.28	0.28		
47: Colvin-----	0-10	27-34	1.20-1.50	0.20-0.60	0.20-0.22	Moderate	4.0-7.0	0.32	0.32	5	4L
	10-25	18-34	1.20-1.50	0.06-2.00	0.16-0.20	Moderate	0.0-5.0	0.32	0.32		
	25-60	18-34	1.30-1.50	0.06-2.00	0.15-0.20	Moderate	0.0-1.0	0.32	0.32		
51: La Prairie-----	0-9	18-27	1.10-1.40	0.60-2.00	0.17-0.22	Low-----	2.0-6.0	0.28	0.28	5	6
	9-38	18-35	1.10-1.50	0.60-2.00	0.17-0.22	Moderate	1.0-4.0	0.28	0.28		
	38-50	18-35	1.30-1.70	0.60-2.00	0.15-0.22	Moderate	0.5-2.0	0.28	0.28		
	50-60	18-30	1.30-1.70	0.60-2.00	0.15-0.22	Moderate	0.5-2.0	0.28	0.28		
60: Glyndon-----	0-10	15-27	1.20-1.40	0.60-2.00	0.20-0.23	Low-----	3.0-7.0	0.28	0.28	5	4L
	10-18	10-18	1.30-1.50	0.60-6.00	0.17-0.20	Low-----	1.0-2.0	0.43	0.43		
	18-60	5-18	1.35-1.65	2.00-6.00	0.15-0.19	Low-----	0.0-0.5	0.43	0.43		
67: Bearden-----	0-11	27-39	1.20-1.40	0.20-0.60	0.17-0.23	Moderate	3.0-7.0	0.28	0.28	5	4L
	11-46	18-34	1.30-1.80	0.20-0.60	0.16-0.22	Moderate	0.0-0.5	0.43	0.43		
	46-60	18-34	1.30-1.80	0.20-0.60	0.16-0.22	Moderate	0.0-0.5	0.43	0.43		
70: Svea-----	0-10	18-26	1.10-1.30	0.60-2.00	0.20-0.24	Low-----	5.0-8.0	0.28	0.32	5	6
	10-26	18-28	1.20-1.50	0.60-2.00	0.17-0.22	Moderate	---	0.28	0.32		
	26-60	18-28	1.20-1.50	0.20-2.00	0.14-0.19	Moderate	---	0.37	0.43		
85: Calco-----	0-10	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L
	10-55	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28		
	55-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32		
108: McIntosh-----	0-9	18-27	1.35-1.50	0.60-2.00	0.20-0.24	Moderate	4.0-7.0	0.28	0.28	5	4L
	9-30	18-35	1.40-1.50	0.60-2.00	0.16-0.22	Moderate	0.5-1.0	0.32	0.32		
	30-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.32	0.32		
113: Webster-----	0-17	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	6.0-7.0	0.24	0.24	5	6
	17-50	25-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	2.0-4.0	0.32	0.32		
	50-60	18-29	1.50-1.70	0.60-2.00	0.17-0.19	Moderate	1.0-2.0	0.32	0.32		
114: Glencoe-----	0-12	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	7
	12-40	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	---	0.28	0.28		
	40-55	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	---	0.28	0.28		
	55-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low-----	---	0.28	0.28		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
127A: Sverdrup-----	0-9	10-18	1.35-1.50	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	4	3
	9-43	6-18	1.40-1.55	2.00-6.00	0.08-0.14	Low-----	1.0-3.0	0.20	0.20		
	43-60	0-10	1.50-1.65	6.00-20.00	0.02-0.06	Low-----	0.0-0.5	0.15	0.15		
127B: Sverdrup-----	0-12	10-18	1.35-1.50	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	4	3
	12-21	6-18	1.40-1.55	2.00-6.00	0.08-0.14	Low-----	1.0-3.0	0.20	0.20		
	21-60	0-10	1.50-1.65	6.00-20.00	0.02-0.06	Low-----	0.0-0.5	0.15	0.15		
127C: Sverdrup-----	0-10	10-18	1.35-1.50	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	4	3
	10-15	6-18	1.40-1.55	2.00-6.00	0.08-0.14	Low-----	1.0-3.0	0.20	0.20		
	15-60	0-10	1.50-1.65	6.00-20.00	0.02-0.06	Low-----	0.0-0.5	0.15	0.15		
137: Dovray-----	0-10	40-60	1.20-1.30	0.06-0.60	0.14-0.18	High-----	5.0-10	0.28	0.28	5	4
	10-25	40-60	1.20-1.30	0.06-0.60	0.13-0.16	High-----	---	0.28	0.28		
	25-47	40-60	1.20-1.30	0.06-0.60	0.13-0.16	High-----	---	0.28	0.28		
	47-60	25-60	1.20-1.40	0.06-0.20	0.13-0.19	High-----	---	0.28	0.28		
141A: Egeland-----	0-9	10-18	1.25-1.35	2.00-6.00	0.11-0.17	Low-----	1.0-3.0	0.20	0.20	5	3
	9-50	10-18	1.30-1.45	2.00-6.00	0.09-0.15	Low-----	0.5-2.0	0.20	0.20		
	50-60	5-10	1.40-1.65	2.00-6.00	0.08-0.10	Low-----	0.0-0.5	0.17	0.17		
141B: Egeland-----	0-13	10-18	1.25-1.35	2.00-6.00	0.11-0.17	Low-----	1.0-3.0	0.20	0.20	5	3
	13-45	10-18	1.30-1.45	2.00-6.00	0.09-0.15	Low-----	0.5-2.0	0.20	0.20		
	45-60	5-10	1.40-1.65	2.00-6.00	0.08-0.10	Low-----	0.0-0.5	0.17	0.17		
141C: Egeland-----	0-11	15-25	1.20-1.30	0.60-2.00	0.18-0.20	Low-----	1.0-3.0	0.28	0.28	5	5
	11-25	10-18	1.30-1.45	2.00-6.00	0.09-0.15	Low-----	0.5-2.0	0.20	0.20		
	25-60	5-10	1.40-1.65	2.00-6.00	0.08-0.10	Low-----	0.0-0.5	0.17	0.17		
168B: Forman-----	0-9	27-30	1.20-1.40	0.60-2.00	0.17-0.19	Moderate	4.0-8.0	0.28	0.28	5	6
	9-25	30-35	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	---	0.28	0.32		
	25-60	18-35	1.30-1.50	0.06-0.60	0.14-0.19	Moderate	---	0.37	0.37		
184: Hamerly-----	0-9	18-27	1.20-1.60	0.60-2.00	0.20-0.24	Low-----	4.0-7.0	0.28	0.28	5	4L
	9-29	18-30	1.20-1.60	0.60-2.00	0.15-0.19	Low-----	0.5-1.0	0.28	0.32		
	29-60	18-30	1.30-1.60	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.37	0.37		
210: Fulda-----	0-13	40-50	1.20-1.30	0.06-0.20	0.14-0.20	High-----	5.0-10	0.28	0.28	5	4
	13-28	35-60	1.20-1.35	0.06-0.20	0.13-0.16	High-----	0.0-2.0	0.28	0.28		
	28-60	35-60	1.20-1.40	0.06-0.20	0.16-0.19	High-----	0.0-1.0	0.28	0.28		
212A: Sinai-----	0-10	27-40	1.15-1.25	0.20-0.60	0.17-0.22	High-----	3.0-7.0	0.28	0.28	5	7
	10-17	35-60	1.20-1.40	0.06-0.20	0.10-0.19	Very high	1.0-3.0	0.28	0.28		
	17-34	35-60	1.20-1.40	0.06-0.20	0.10-0.19	Very high	0.5-2.0	0.28	0.28		
	34-60	30-50	1.35-1.40	0.06-0.20	0.10-0.19	Very high	0.0-0.5	0.43	0.43		
212B: Sinai-----	0-10	40-60	1.15-1.30	0.06-0.20	0.13-0.16	High-----	3.0-7.0	0.28	0.28	5	4
	10-19	45-60	1.20-1.40	0.06-0.20	0.17-0.19	Very high	1.0-3.0	0.37	0.37		
	19-45	45-60	1.20-1.40	0.01-0.20	0.11-0.17	Very high	0.5-2.0	0.37	0.37		
	45-60	30-50	1.35-1.40	0.01-0.20	0.11-0.17	High-----	0.0-0.5	0.43	0.43		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
219: Rolfe-----	0-22	22-27	1.35-1.40	0.60-2.00	0.22-0.24	Low-----	3.0-5.0	0.37	0.37	3	6
	22-34	38-45	1.40-1.50	0.06-0.20	0.11-0.13	High-----	1.0-2.0	0.28	0.28		
	34-60	24-35	1.50-1.60	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.28	0.28		
220D2: Langhei-----	0-6	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	0.5-3.0	0.32	0.32	5	4L
	6-16	18-32	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.32	0.32		
	16-60	18-32	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.32	0.32		
236: Vallers-----	0-15	28-35	1.20-1.35	0.20-0.60	0.18-0.22	Moderate	5.0-8.0	0.28	0.28	5	4L
	15-30	18-35	1.40-1.55	0.20-0.60	0.15-0.19	Moderate	1.0-3.0	0.28	0.28		
	30-60	18-35	1.50-1.70	0.20-0.60	0.17-0.19	Low-----	0.0-0.5	0.28	0.28		
246: Marysland-----	0-17	18-27	1.20-1.30	0.60-2.00	0.17-0.22	Moderate	5.0-8.0	0.28	0.28	4	4L
	17-25	18-30	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28		
	25-60	1-5	1.55-1.65	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.15	0.15		
276: Oldham-----	0-17	40-45	1.15-1.30	0.06-0.20	0.13-0.19	High-----	4.0-7.0	0.28	0.28	5	4
	17-55	35-45	1.25-1.40	0.06-0.60	0.14-0.20	High-----	2.0-5.0	0.37	0.37		
	55-60	20-40	1.30-1.50	0.06-0.60	0.14-0.20	Moderate	0.0-0.5	0.43	0.43		
284B: Poinsett-----	0-12	27-30	1.15-1.25	0.60-2.00	0.19-0.22	Moderate	4.0-6.0	0.28	0.28	5	7
	12-20	20-32	1.20-1.35	0.60-2.00	0.18-0.21	Moderate	2.0-4.0	0.32	0.32		
	20-26	20-32	1.20-1.35	0.60-2.00	0.18-0.21	Moderate	0.5-1.0	0.43	0.43		
	26-60	25-30	1.50-1.70	0.20-0.60	0.16-0.19	Moderate	0.0-0.5	0.37	0.37		
288F: Esmond-----	0-7	10-18	1.30-1.60	0.60-2.00	0.20-0.22	Low-----	1.0-4.0	0.28	0.28	5	4L
	7-60	7-18	1.40-1.60	0.60-2.00	0.14-0.22	Low-----	---	0.37	0.43		
290B: Rothsay-----	0-10	10-18	1.20-1.40	0.60-2.00	0.22-0.24	Low-----	3.0-6.0	0.32	0.32	5	5
	10-25	10-18	1.20-1.40	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.43	0.43		
	25-60	5-18	1.20-1.40	0.60-6.00	0.20-0.22	Low-----	0.0-0.5	0.43	0.43		
293B: Swenoda-----	0-10	15-25	1.20-1.30	0.60-2.00	0.18-0.20	Low-----	3.0-7.0	0.24	0.24	5	5
	10-25	10-18	1.30-1.45	2.00-6.00	0.11-0.17	Low-----	1.0-3.0	0.20	0.20		
	25-60	20-35	1.35-1.65	0.20-2.00	0.17-0.20	Moderate	0.5-1.0	0.37	0.37		
314: Spottswood-----	0-8	20-26	1.15-1.30	0.60-2.00	0.18-0.22	Low-----	4.0-8.0	0.24	0.24	4	6
	8-32	18-30	1.25-1.40	0.60-2.00	0.18-0.22	Moderate	1.0-4.0	0.28	0.28		
	32-60	2-8	1.50-1.70	6.00-20.00	0.03-0.06	Low-----	0.0-0.5	0.10	0.17		
338: Waubay-----	0-12	27-35	1.35-1.45	0.60-2.00	0.19-0.22	Moderate	4.0-8.0	0.28	0.28	5	7
	12-16	20-35	1.35-1.45	0.60-2.00	0.18-0.21	Moderate	2.0-4.0	0.32	0.32		
	16-34	20-35	1.35-1.45	0.60-2.00	0.17-0.20	Moderate	0.5-3.0	0.43	0.43		
	34-60	20-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	0.0-1.0	0.43	0.43		
339: Fordville-----	0-9	18-25	1.20-1.30	0.60-2.00	0.18-0.20	Low-----	3.0-7.0	0.24	0.24	4	6
	9-16	18-30	1.25-1.40	0.60-2.00	0.18-0.21	Moderate	1.0-4.0	0.28	0.28		
	16-21	15-30	1.25-1.45	0.60-6.00	0.12-0.18	Low-----	0.0-2.0	0.28	0.28		
	21-60	0-5	1.60-1.80	6.00-20.00	0.03-0.06	Low-----	0.0-0.5	0.10	0.17		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
341A: Arvilla-----	0-9	6-18	1.40-1.60	2.00-6.00	0.13-0.15	Low-----	1.0-4.0	0.20	0.20	3	3
	9-23	6-18	1.40-1.60	2.00-6.00	0.11-0.14	Low-----	1.0-2.0	0.20	0.20		
	23-60	2-10	1.40-1.60	6.00-20.00	0.02-0.05	Low-----	0.0-0.5	0.10	0.20		
341B: Arvilla-----	0-10	6-18	1.40-1.60	2.00-6.00	0.13-0.15	Low-----	1.0-4.0	0.20	0.20	3	3
	10-13	6-18	1.40-1.60	2.00-6.00	0.11-0.14	Low-----	1.0-2.0	0.20	0.20		
	13-60	2-10	1.40-1.60	6.00-20.00	0.02-0.05	Low-----	0.0-0.5	0.10	0.20		
341C: Arvilla-----	0-9	6-18	1.40-1.60	2.00-6.00	0.13-0.15	Low-----	1.0-4.0	0.20	0.20	3	3
	9-14	6-18	1.40-1.60	2.00-6.00	0.11-0.14	Low-----	1.0-2.0	0.20	0.20		
	14-60	2-10	1.40-1.60	6.00-20.00	0.02-0.05	Low-----	0.0-0.5	0.10	0.20		
344: Quam-----	0-9	28-35	1.00-1.35	0.20-0.60	0.18-0.22	Moderate	6.0-15	0.28	0.28	5	7
	9-54	22-35	1.25-1.45	0.20-0.60	0.16-0.22	Moderate	4.0-10	0.28	0.28		
	54-60	20-35	1.40-1.65	0.20-0.60	0.14-0.19	Moderate	1.0-3.0	0.37	0.37		
347: Malachy-----	0-18	10-22	1.25-1.40	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.20	0.24	4	4L
	18-30	5-18	1.35-1.50	0.60-6.00	0.12-0.19	Low-----	0.5-1.0	0.20	0.24		
	30-60	2-10	1.45-1.65	6.00-20.00	0.02-0.10	Low-----	0.0-0.5	0.10	0.15		
375: Forada-----	0-21	10-22	1.20-1.40	0.60-2.00	0.20-0.22	Low-----	5.0-9.0	0.24	0.24	4	5
	21-35	8-18	1.30-1.50	0.60-6.00	0.12-0.19	Low-----	0.5-1.0	0.28	0.28		
	35-60	0-5	1.50-1.70	6.00-20.00	0.02-0.10	Low-----	0.0-0.5	0.15	0.17		
396D2: Sisseton-----	0-6	15-20	1.20-1.30	0.60-2.00	0.16-0.18	Low-----	1.0-3.0	0.28	0.28	5	4L
	6-18	10-18	1.20-1.35	0.60-2.00	0.16-0.20	Low-----	0.0-1.0	0.32	0.32		
	18-60	10-18	1.30-1.50	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.43	0.43		
402F: Sioux-----	0-7	10-20	1.30-1.50	2.00-6.00	0.10-0.15	Low-----	1.0-3.0	0.15	0.20	2	8
	7-10	10-20	1.20-1.50	2.00-6.00	0.10-0.15	Low-----	0.5-2.0	0.15	0.20		
	10-60	0-10	1.60-1.70	6.00-20.00	0.03-0.06	Low-----	0.0-0.5	0.10	0.15		
418: Lamoure-----	0-9	27-34	1.15-1.25	0.20-2.00	0.19-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L
	9-55	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	1.0-3.0	0.32	0.32		
	55-60	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	0.5-1.0	0.43	0.43		
421B: Ves-----	0-10	20-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6
	10-25	20-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32		
	25-60	20-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
423: Seaforth-----	0-9	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L
	9-21	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28		
	21-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-2.0	0.28	0.28		
434: Perella-----	0-16	20-39	1.20-1.40	0.20-2.00	0.18-0.23	Moderate	4.0-8.0	0.28	0.28	5	7
	16-25	18-34	1.30-1.50	0.06-2.00	0.15-0.22	Moderate	---	0.28	0.28		
	25-60	18-34	1.30-1.60	0.20-2.00	0.16-0.22	Moderate	---	0.28	0.28		
437F: Buse-----	0-7	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	7-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
446: Normania-----	0-14	27-32	1.20-1.35	0.60-2.00	0.17-0.19	Moderate	4.0-8.0	0.24	0.24	5	6
	14-23	22-32	1.30-1.40	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.24	0.24		
	23-60	22-32	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.32	0.32		
450: Rauville-----	0-42	27-35	1.10-1.25	0.20-2.00	0.19-0.22	Moderate	4.0-7.0	0.28	0.28	5	8
	42-60	20-35	1.10-1.30	0.20-2.00	0.17-0.20	Moderate	2.0-6.0	0.28	0.28		
494B: Darnen-----	0-26	18-27	1.25-1.40	0.60-2.00	0.20-0.24	Low-----	4.0-9.0	0.28	0.28	5	6
	26-44	18-30	1.40-1.60	0.60-2.00	0.15-0.19	Moderate	---	0.28	0.28		
	44-60	18-30	1.55-1.65	0.60-2.00	0.14-0.19	Moderate	---	0.37	0.37		
497: Hantho-----	0-10	10-27	1.20-1.40	0.20-2.00	0.22-0.24	Low-----	4.0-6.0	0.28	0.28	5	5
	10-22	10-18	1.30-1.50	0.60-2.00	0.17-0.22	Low-----	2.0-4.0	0.28	0.28		
	22-60	10-18	1.30-1.55	0.60-2.00	0.17-0.22	Low-----	0.0-1.0	0.43	0.43		
509: Vallers-----	0-13	28-35	1.20-1.35	0.20-0.60	0.18-0.22	Moderate	5.0-8.0	0.28	0.28	5	4L
	13-19	18-35	1.40-1.55	0.20-0.60	0.15-0.19	Moderate	1.0-3.0	0.28	0.28		
	19-60	18-35	1.50-1.70	0.20-0.60	0.17-0.19	Low-----	0.0-0.5	0.28	0.28		
574: Du Page-----	0-46	18-27	1.40-1.60	0.60-2.00	0.22-0.24	Moderate	3.0-5.0	0.28	0.28	5	6
	46-60	18-27	1.45-1.65	0.60-2.00	0.10-0.20	Low-----	0.1-2.0	0.28	0.32		
597: Tara-----	0-10	18-27	1.40-1.50	0.60-2.00	0.20-0.24	Low-----	4.0-8.0	0.28	0.28	5	6
	10-25	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	0.5-2.0	0.28	0.28		
	25-36	18-27	1.40-1.55	0.60-2.00	0.17-0.21	Low-----	0.5-2.0	0.28	0.28		
	36-60	18-30	1.35-1.60	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.37	0.37		
610: Calco-----	0-41	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L
	41-46	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28		
	46-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32		
680: Parnell-----	0-17	27-40	1.20-1.30	0.20-0.60	0.18-0.22	Moderate	5.0-8.0	0.28	0.28	5	7
	17-39	35-60	1.45-1.65	0.06-0.20	0.13-0.19	High-----	---	0.28	0.28		
	39-60	22-40	1.50-1.70	0.06-0.60	0.14-0.19	Moderate	---	0.28	0.28		
694C2: Zell-----	0-7	10-18	1.15-1.30	0.60-2.00	0.19-0.22	Low-----	2.0-5.0	0.32	0.32	5	4L
	7-11	10-18	1.25-1.40	0.60-2.00	0.15-0.20	Low-----	0.0-3.0	0.43	0.43		
	11-60	5-18	1.25-1.40	0.60-2.00	0.15-0.20	Low-----	0.0-0.5	0.43	0.43		
706: Bigstone-----	0-11	28-35	1.00-1.35	0.20-0.60	0.18-0.22	Moderate	6.0-15	0.28	0.28	5	8
	11-30	20-35	1.35-1.50	0.20-2.00	0.16-0.22	Moderate	2.0-4.0	0.28	0.28		
	30-60	20-32	1.35-1.50	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37		
724: Bigstone-----	0-9	28-35	1.00-1.35	0.20-0.60	0.18-0.22	Moderate	6.0-15	0.28	0.28	5	4L
	9-54	20-35	1.35-1.50	0.20-2.00	0.16-0.22	Moderate	2.0-4.0	0.28	0.28		
	54-60	20-32	1.35-1.50	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37		
741B: Poinsett-----	0-9	27-30	1.15-1.25	0.60-2.00	0.19-0.22	Moderate	4.0-6.0	0.28	0.28	5	7
	9-17	20-32	1.20-1.35	0.60-2.00	0.18-0.21	Moderate	2.0-4.0	0.32	0.32		
	17-60	20-32	1.20-1.35	0.60-2.00	0.18-0.21	Moderate	0.5-1.0	0.43	0.43		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
741B: Buse-----	0-9	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	9-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		
748B: Hamlet-----	0-10	18-26	1.10-1.30	0.60-2.00	0.20-0.22	Low-----	4.0-8.0	0.32	0.32	5	6
	10-38	18-35	1.20-1.50	0.60-2.00	0.15-0.19	Moderate	---	0.32	0.32		
	38-60	18-35	1.20-1.50	0.20-2.00	0.14-0.19	Moderate	---	0.32	0.32		
769A: Mehurin-----	0-9	27-35	1.25-1.35	0.20-0.60	0.17-0.19	Moderate	4.0-8.0	0.24	---	5	6
	9-14	35-60	1.25-1.40	0.06-0.60	0.10-0.19	High-----	1.0-2.0	0.32	---		
	14-21	20-35	1.20-1.60	0.20-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	---		
	21-60	20-30	1.20-1.60	0.20-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	---		
769B: Mehurin-----	0-8	27-35	1.25-1.35	0.20-0.60	0.17-0.19	Moderate	4.0-8.0	0.24	---	5	6
	8-17	35-60	1.25-1.40	0.06-0.60	0.10-0.19	High-----	1.0-2.0	0.32	---		
	17-30	20-35	1.20-1.60	0.20-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	---		
	30-60	20-30	1.20-1.60	0.20-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	---		
774: Svea-----	0-10	18-26	1.10-1.30	0.60-2.00	0.20-0.24	Low-----	5.0-8.0	0.28	0.32	5	6
	10-23	18-28	1.20-1.50	0.60-2.00	0.17-0.22	Moderate	---	0.28	0.32		
	23-60	18-28	1.20-1.50	0.20-2.00	0.14-0.19	Moderate	---	0.37	0.43		
777C2: Sisseton-----	0-6	15-20	1.20-1.30	0.60-2.00	0.16-0.18	Low-----	1.0-3.0	0.28	0.28	5	4L
	6-24	10-18	1.20-1.35	0.60-2.00	0.16-0.20	Low-----	0.0-1.0	0.32	0.32		
	24-60	10-18	1.30-1.50	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.43	0.43		
Heimdal-----	0-8	10-20	1.30-1.60	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	---	5	5
	8-26	10-18	1.35-1.65	0.60-2.00	0.12-0.19	Low-----	0.5-1.0	0.28	---		
	26-47	10-18	1.45-1.65	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.28	---		
	47-60	7-18	1.65-1.80	0.60-2.00	0.11-0.16	Low-----	0.0-0.5	0.28	---		
883: Du Page-----	0-38	18-27	1.40-1.60	0.60-2.00	0.22-0.24	Moderate	3.0-5.0	0.28	0.28	5	6
	38-60	18-27	1.45-1.65	0.60-2.00	0.10-0.20	Low-----	0.1-2.0	0.28	0.32		
Zumbro-----	0-9	5-18	1.35-1.45	2.00-6.00	0.13-0.18	Low-----	2.0-4.0	0.20	0.20	5	3
	9-32	2-10	1.45-1.55	6.00-20.00	0.10-0.12	Low-----	1.0-2.0	0.17	0.17		
	32-47	0-10	1.45-1.60	6.00-20.00	0.06-0.11	Low-----	0.0-2.0	0.17	0.17		
	47-60	0-5	1.55-1.65	6.00-20.00	0.02-0.07	Low-----	0.0-1.0	0.17	0.17		
891B: Doland-----	0-10	18-27	1.30-1.45	0.60-2.00	0.24-0.28	Low-----	4.0-6.0	0.32	0.32	5	6
	10-28	18-27	1.35-1.50	0.60-2.00	0.17-0.22	Low-----	---	0.32	0.32		
	28-60	18-30	1.45-1.70	0.60-2.00	0.14-0.19	Low-----	---	0.32	0.32		
Buse-----	0-8	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	8-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		
902B: Barnes-----	0-10	18-27	1.40-1.50	0.60-2.00	0.18-0.24	Low-----	2.0-5.0	0.28	0.32	5	6
	10-21	18-27	1.50-1.60	0.60-2.00	0.15-0.19	Low-----	0.5-1.0	0.28	0.32		
	21-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.37	0.43		
Buse-----	0-8	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	8-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
915C2:											
Buse-----	0-7	18-27	1.40-1.50	0.20-0.60	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	7-60	18-35	1.55-1.65	0.20-0.60	0.14-0.19	Moderate	---	0.37	0.37		
Forman-----	0-9	27-30	1.20-1.40	0.60-2.00	0.17-0.19	Moderate	4.0-8.0	0.28	0.28	5	6
	9-15	30-35	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	---	0.28	0.32		
	15-60	18-35	1.30-1.50	0.06-0.60	0.14-0.19	Moderate	---	0.37	0.37		
942C2:											
Langhei-----	0-5	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	0.5-3.0	0.32	0.32	5	4L
	5-23	18-32	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.32	0.32		
	23-60	18-32	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.32	0.32		
Barnes-----	0-9	18-27	1.40-1.50	0.60-2.00	0.18-0.24	Low-----	2.0-5.0	0.28	0.32	5	6
	9-32	18-27	1.50-1.60	0.60-2.00	0.15-0.19	Low-----	0.5-1.0	0.28	0.32		
	32-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.37	0.43		
954B:											
Ves-----	0-9	20-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6
	9-21	20-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32		
	21-60	20-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
Swanlake-----	0-8	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L
	8-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37		
954C2:											
Storden-----	0-5	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L
	5-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
Ves-----	0-8	20-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6
	8-22	20-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32		
	22-60	20-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
969B:											
Zell-----	0-9	10-18	1.15-1.30	0.60-2.00	0.19-0.22	Low-----	2.0-5.0	0.32	0.32	5	4L
	9-21	10-18	1.25-1.40	0.60-2.00	0.15-0.20	Low-----	0.0-3.0	0.43	0.43		
	21-60	5-18	1.25-1.40	0.60-2.00	0.15-0.20	Low-----	0.0-0.5	0.43	0.43		
Rothsay-----	0-9	10-18	1.20-1.40	0.60-2.00	0.22-0.24	Low-----	3.0-6.0	0.32	0.32	5	5
	9-23	10-18	1.20-1.40	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.43	0.43		
	23-60	5-18	1.20-1.40	0.60-6.00	0.20-0.22	Low-----	0.0-0.5	0.43	0.43		
1013:											
Pits-----	0-60	---	---	0.01-0.06	---	-----	---	---	---	---	---
1030:											
Udorthents.											
Pits.											
1051:											
Glencoe-----	0-45	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	8
	45-57	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	---	0.28	0.28		
	57-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low-----	---	0.28	0.28		
1106C:											
Storden-----	0-5	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L
	5-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
Hawick-----	0-9	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low-----	1.0-3.0	0.10	0.15	5	8
	9-20	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15		
	20-60	1-5	1.55-1.65	>20.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
1106C: Ves-----	0-8	20-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6
	8-23	20-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32		
	23-60	20-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37		
1107D: Sisseton-----	0-5	15-20	1.20-1.30	0.60-2.00	0.16-0.18	Low-----	1.0-3.0	0.28	0.28	5	4L
	5-31	10-18	1.20-1.35	0.60-2.00	0.16-0.20	Low-----	0.0-1.0	0.32	0.32		
	31-60	10-18	1.30-1.50	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.43	0.43		
Sioux-----	0-7	10-20	1.30-1.50	2.00-6.00	0.10-0.15	Low-----	1.0-3.0	0.15	0.20	2	8
	7-29	10-20	1.20-1.50	2.00-6.00	0.10-0.15	Low-----	0.5-2.0	0.15	0.20		
	29-60	0-10	1.60-1.70	6.00-20.00	0.03-0.06	Low-----	0.0-0.5	0.10	0.15		
Heimdal-----	0-7	10-20	1.30-1.60	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	---	5	5
	7-21	10-18	1.35-1.65	0.60-2.00	0.12-0.19	Low-----	0.5-1.0	0.28	---		
	21-60	10-18	1.45-1.65	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.28	---		
1108: Harps-----	0-16	25-27	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	4.0-5.0	0.24	0.24	5	4L
	16-38	18-32	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	2.0-3.0	0.32	0.32		
	38-60	20-30	1.50-1.70	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.32	0.32		
Glencoe-----	0-10	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	7
	10-30	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	---	0.28	0.28		
	30-57	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	---	0.28	0.28		
	57-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low-----	---	0.28	0.28		
Seaforth-----	0-9	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L
	9-30	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28		
	30-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-2.0	0.28	0.28		
1222: Parle-----	0-9	27-40	1.25-1.40	0.20-0.60	0.17-0.19	Moderate	4.0-8.0	0.24	0.24	5	4L
	9-26	18-35	1.20-1.40	0.20-2.00	0.17-0.22	Moderate	2.0-4.0	0.32	0.32		
	26-34	18-35	1.20-1.50	0.20-2.00	0.15-0.19	Moderate	0.5-1.0	0.37	0.37		
	34-50	18-35	1.35-1.50	0.20-2.00	0.15-0.22	Moderate	0.5-1.0	0.43	0.43		
	50-60	2-15	1.40-1.60	2.00-20.00	0.08-0.10	Low-----	0.0-0.5	0.17	0.17		
1233B: Esmond-----	0-9	10-18	1.30-1.60	0.60-2.00	0.20-0.22	Low-----	1.0-4.0	0.28	0.28	5	4L
	9-60	7-18	1.40-1.60	0.60-2.00	0.14-0.22	Low-----	---	0.37	0.43		
Heimdal-----	0-9	10-20	1.30-1.60	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	---	5	5
	9-25	10-18	1.35-1.65	0.60-2.00	0.12-0.19	Low-----	0.5-1.0	0.28	---		
	25-60	10-18	1.45-1.65	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.28	---		
1266C: Yellowbank-----	0-12	10-27	1.30-1.45	0.60-2.00	0.20-0.22	Low-----	2.0-10	0.20	0.24	2	6
	12-16	5-20	1.30-1.60	0.60-6.00	0.12-0.22	Low-----	0.5-2.0	0.24	0.32		
	16-26	---	---	---	---	---	---	---	---		
Rock outcrop---	0-60	---	---	0.00-20.00	---	---	---	---	---	---	8
1295B: Doland-----	0-8	18-27	1.30-1.45	0.60-2.00	0.20-0.24	Low-----	4.0-6.0	0.32	0.32	5	6
	8-23	18-30	1.35-1.50	0.60-2.00	0.17-0.24	Low-----	0.5-2.0	0.32	0.32		
	23-42	18-30	1.45-1.70	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.32	0.32		
	42-60	18-30	1.45-1.70	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.32	0.32		

## PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group
								K	Kf	T	
	In	Pct	g/cc	In/hr	In/in		Pct				
1296: Swnoda-----	0-16	10-20	1.25-1.35	2.00-6.00	0.11-0.17	Low-----	2.0-7.0	0.20	0.20	5	3
	16-21	10-18	1.30-1.45	2.00-6.00	0.11-0.17	Low-----	1.0-3.0	0.20	0.20		
	21-60	20-35	1.35-1.65	0.20-2.00	0.17-0.20	Moderate	0.0-1.0	0.43	0.43		
1309C: Buse-----	0-8	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	8-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		
Doland-----	0-9	18-27	1.30-1.45	0.60-2.00	0.24-0.28	Low-----	4.0-6.0	0.32	0.32	5	6
	9-18	18-27	1.35-1.50	0.60-2.00	0.17-0.22	Low-----	---	0.32	0.32		
	18-60	18-30	1.45-1.70	0.60-2.00	0.14-0.19	Low-----	---	0.32	0.32		
1865C: Buse-----	0-8	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	8-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		
Barnes-----	0-15	18-27	1.40-1.50	0.60-2.00	0.18-0.24	Low-----	2.0-5.0	0.28	0.32	5	6
	15-22	18-27	1.50-1.60	0.60-2.00	0.15-0.19	Low-----	0.5-1.0	0.28	0.32		
	22-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.0-0.5	0.37	0.43		
1865F: Buse-----	0-7	18-27	1.40-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-3.0	0.28	0.28	5	4L
	7-60	18-27	1.50-1.60	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.37	0.37		
1870: Burr-----	0-9	30-40	1.00-1.10	0.20-2.00	0.18-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L
	9-45	35-45	1.10-1.25	0.06-0.60	0.13-0.19	Moderate	3.0-6.0	0.32	0.32		
	45-60	27-45	1.20-1.30	0.06-0.60	0.09-0.22	Moderate	0.0-1.0	0.32	0.32		
Calco-----	0-30	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L
	30-51	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28		
	51-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32		
1938: Lakepark-----	0-10	20-27	1.30-1.45	0.20-0.60	0.19-0.21	Low-----	5.0-8.0	0.24	0.24	5	6
	10-26	20-35	1.30-1.45	0.20-0.60	0.19-0.21	Low-----	---	0.24	0.24		
	26-37	22-35	1.40-1.50	0.20-0.60	0.15-0.19	Moderate	---	0.32	0.32		
	37-60	22-35	1.50-1.70	0.20-0.60	0.14-0.19	Moderate	---	0.32	0.32		
1994: Embsen-----	0-17	10-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	4.0-7.0	0.20	0.20	5	3
	17-60	10-18	1.40-1.60	2.00-6.00	0.12-0.17	Low-----	---	0.20	0.20		

## CHEMICAL PROPERTIES OF THE SOILS

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
31D2: Storden-----	0-5	18-27	11.0-18.0	7.4-8.4	5-25	---
	5-60	18-30	9.0-17.0	7.4-8.4	5-25	---
34: Parnell-----	0-18	27-40	---	6.1-7.8	---	---
	18-38	35-60	---	6.1-7.8	---	---
	38-60	35-45	---	6.6-8.4	---	---
47: Colvin-----	0-10	27-34	25.0-40.0	6.6-8.4	0-10	---
	10-25	18-34	15.0-25.0	7.4-8.4	10-45	---
	25-60	18-34	10.0-20.0	7.4-8.4	5-20	---
51: La Prairie-----	0-9	18-27	20.0-35.0	6.6-8.4	0-3	---
	9-38	18-35	20.0-35.0	6.6-8.4	0-10	---
	38-50	18-35	20.0-25.0	6.6-8.4	10-30	---
	50-60	18-30	20.0-25.0	6.6-8.4	10-30	---
60: Glyndon-----	0-10	15-27	12.0-28.0	7.4-9.0	15-25	0-4
	10-18	10-18	6.0-14.0	7.4-9.0	20-40	0-4
	18-60	5-18	2.0-10.0	7.4-9.0	15-35	0-4
67: Bearden-----	0-11	27-39	16.0-33.0	7.4-8.4	1-10	0-4
	11-46	18-34	10.0-20.0	7.4-8.4	15-35	0-4
	46-60	18-34	10.0-20.0	7.4-8.4	10-25	0-8
70: Svea-----	0-10	18-26	---	6.1-7.8	---	---
	10-26	18-28	---	6.6-7.8	---	---
	26-60	18-28	---	7.4-8.4	---	---
85: Calco-----	0-10	28-33	36.0-41.0	7.4-8.4	5-30	---
	10-55	30-35	36.0-41.0	7.4-8.4	5-30	---
	55-60	22-32	36.0-41.0	7.4-8.4	5-30	---
108: McIntosh-----	0-9	18-27	19.0-36.0	7.4-8.4	5-30	---
	9-30	18-35	15.0-38.0	7.4-8.4	20-35	---
	30-60	18-35	9.0-27.0	7.4-8.4	5-30	---
113: Webster-----	0-17	27-35	35.0-41.0	6.6-7.3	---	---
	17-50	25-35	35.0-41.0	6.6-7.8	5-10	---
	50-60	18-29	30.0-35.0	7.4-8.4	5-30	---
114: Glencoe-----	0-12	27-35	---	6.1-7.8	---	---
	12-40	25-35	---	6.1-7.8	---	---
	40-55	25-35	---	6.6-7.8	---	---
	55-60	22-32	---	7.4-7.8	---	---
127A: Sverdrup-----	0-9	10-18	8.0-20.0	6.1-7.3	---	---
	9-43	6-18	4.0-17.0	6.1-7.8	0-15	---
	43-60	0-10	0.0-6.0	7.4-8.4	5-30	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
127B: Sverdrup-----	0-12	10-18	8.0-20.0	6.1-7.3	---	---
	12-21	6-18	4.0-17.0	6.1-7.8	0-15	---
	21-60	0-10	0.0-6.0	7.4-8.4	5-30	---
127C: Sverdrup-----	0-10	10-18	8.0-20.0	6.1-7.3	---	---
	10-15	6-18	4.0-17.0	6.1-7.8	0-15	---
	15-60	0-10	0.0-6.0	7.4-8.4	5-30	---
137: Dovray-----	0-10	40-60	30.0-50.0	6.1-7.8	---	---
	10-25	40-60	20.0-30.0	6.1-7.8	---	---
	25-47	40-60	20.0-30.0	6.6-7.8	---	---
	47-60	25-60	20.0-30.0	6.6-8.4	---	---
141A: Egeland-----	0-9	10-18	15.0-20.0	5.6-7.3	---	0-2
	9-50	10-18	15.0-20.0	6.1-7.8	---	0-2
	50-60	5-10	5.0-15.0	6.6-8.4	10-20	0-2
141B: Egeland-----	0-13	10-18	15.0-20.0	5.6-7.3	---	0-2
	13-45	10-18	15.0-20.0	6.1-7.8	---	0-2
	45-60	5-10	5.0-15.0	6.6-8.4	10-20	0-2
141C: Egeland-----	0-11	15-25	15.0-25.0	5.6-7.3	---	0-2
	11-25	10-18	15.0-20.0	6.1-7.8	---	0-2
	25-60	5-10	5.0-15.0	6.6-8.4	10-20	0-2
168B: Forman-----	0-9	27-30	---	6.6-7.8	---	0-2
	9-25	30-35	---	6.6-7.8	---	0-2
	25-60	18-35	---	7.4-8.4	---	0-4
184: Hamerly-----	0-9	18-27	15.0-30.0	6.6-8.4	0-15	---
	9-29	18-30	8.0-20.0	7.4-8.4	15-30	---
	29-60	18-30	7.0-19.0	7.4-8.4	10-25	---
210: Fulda-----	0-13	40-50	30.0-40.0	6.6-7.3	---	---
	13-28	35-60	20.0-25.0	7.4-8.4	1-10	---
	28-60	35-60	20.0-25.0	7.4-8.4	5-20	---
212A: Sinai-----	0-10	27-40	25.0-35.0	6.1-7.3	0-5	0-2
	10-17	35-60	30.0-40.0	6.6-7.8	0-5	0-2
	17-34	35-60	30.0-40.0	7.4-8.4	5-15	0-2
	34-60	30-50	25.0-40.0	7.4-8.4	5-15	0-2
212B: Sinai-----	0-10	40-60	30.0-40.0	6.1-7.3	0-8	0-2
	10-19	45-60	30.0-40.0	6.6-7.8	5-10	0-2
	19-45	45-60	30.0-40.0	7.4-8.4	5-15	0-2
	45-60	30-50	25.0-40.0	7.4-8.4	5-15	0-2
219: Rolfe-----	0-22	22-27	20.0-25.0	5.1-7.3	---	---
	22-34	38-45	20.0-30.0	6.1-7.3	---	---
	34-60	24-35	20.0-25.0	6.1-8.4	0-25	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
220D2: Langhei-----	0-6	18-27	10.0-30.0	6.6-8.4	0-30	---
	6-16	18-32	10.0-25.0	7.9-8.4	20-35	---
	16-60	18-32	10.0-25.0	7.4-8.4	15-30	---
236: Vallers-----	0-15	28-35	15.0-28.0	7.4-8.4	12-25	0-4
	15-30	18-35	10.0-18.0	7.4-8.4	20-35	0-4
	30-60	18-35	8.0-16.0	7.4-8.4	12-25	0-4
246: Marysland-----	0-17	18-27	18.0-30.0	7.9-8.4	10-35	---
	17-25	18-30	10.0-18.0	7.9-8.4	15-35	---
	25-60	1-5	1.0-4.0	7.9-8.4	10-30	---
276: Oldham-----	0-17	40-45	25.0-45.0	6.6-7.8	0-5	0-4
	17-55	35-45	25.0-35.0	7.4-8.4	5-10	0-4
	55-60	20-40	20.0-30.0	7.4-8.4	5-10	0-2
284B: Poinsett-----	0-12	27-30	19.0-29.0	6.1-7.3	---	0-2
	12-20	20-32	14.0-24.0	6.1-7.8	0-3	0-2
	20-26	20-32	12.0-22.0	7.4-8.4	10-30	0-2
	26-60	25-30	8.0-14.0	7.4-8.4	10-30	0-8
288F: Esmond-----	0-7	10-18	---	7.4-8.4	---	---
	7-60	7-18	---	7.4-8.4	---	---
290B: Rothsay-----	0-10	10-18	10.0-20.0	6.6-7.3	0-5	---
	10-25	10-18	6.0-12.0	6.6-7.8	0-10	---
	25-60	5-18	5.0-10.0	7.4-8.4	5-20	---
293B: Swenoda-----	0-10	15-25	15.0-30.0	6.1-7.3	---	0-2
	10-25	10-18	10.0-25.0	6.6-7.8	---	0-2
	25-60	20-35	15.0-30.0	7.4-8.4	10-20	0-4
314: Spottswood-----	0-8	20-26	20.0-25.0	6.1-7.3	0-1	0-2
	8-32	18-30	15.0-25.0	6.6-8.4	2-15	0-2
	32-60	2-8	1.0-10.0	7.4-8.4	2-20	0-2
338: Waubay-----	0-12	27-35	25.0-32.0	6.1-7.3	---	0-2
	12-16	20-35	19.0-27.0	6.6-7.8	0-3	0-2
	16-34	20-35	17.0-25.0	7.4-8.4	15-20	0-2
	34-60	20-35	20.0-25.0	7.4-8.4	15-20	0-4
339: Fordville-----	0-9	18-25	21.0-27.0	6.1-7.3	0-1	0-2
	9-16	18-30	21.0-27.0	6.1-7.8	2-15	0-2
	16-21	15-30	15.0-25.0	6.1-8.4	2-20	0-2
	21-60	0-5	1.0-10.0	7.4-8.4	2-20	0-2
341A: Arvilla-----	0-9	6-18	5.0-20.0	6.1-8.4	---	---
	9-23	6-18	5.0-15.0	6.6-8.4	---	---
	23-60	2-10	1.0-5.0	7.4-8.4	1-5	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
341B: Arvilla-----	0-10	6-18	5.0-20.0	6.1-8.4	---	---
	10-13	6-18	5.0-15.0	6.6-8.4	---	---
	13-60	2-10	1.0-5.0	7.4-8.4	1-5	---
341C: Arvilla-----	0-9	6-18	5.0-20.0	6.1-8.4	---	---
	9-14	6-18	5.0-15.0	6.6-8.4	---	---
	14-60	2-10	1.0-5.0	7.4-8.4	1-5	---
344: Quam-----	0-9	28-35	25.0-45.0	6.6-7.8	---	---
	9-54	22-35	20.0-40.0	6.6-7.8	0-15	---
	54-60	20-35	12.0-25.0	7.4-8.4	5-20	---
347: Malachy-----	0-18	10-22	10.0-25.0	7.4-8.4	1-10	---
	18-30	5-18	3.0-13.0	7.4-8.4	5-20	---
	30-60	2-10	1.0-7.0	7.4-8.4	5-20	---
375: Forada-----	0-21	10-22	14.0-30.0	6.1-7.8	0-15	---
	21-35	8-18	4.0-12.0	6.1-7.8	0-15	---
	35-60	0-5	0.0-5.0	6.6-8.4	0-10	---
396D2: Sisseton-----	0-6	15-20	25.0-35.0	7.4-8.4	0-5	0-2
	6-18	10-18	20.0-30.0	7.4-8.4	15-35	0-2
	18-60	10-18	20.0-30.0	7.4-8.4	7-30	0-2
402F: Sioux-----	0-7	10-20	15.0-20.0	6.6-8.4	---	0-2
	7-10	10-20	15.0-20.0	7.4-8.4	0-15	0-2
	10-60	0-10	15.0-20.0	7.4-8.4	0-15	0-2
418: Lamoure-----	0-9	27-34	25.0-32.0	7.4-8.4	0-10	0-4
	9-55	20-34	24.0-31.0	7.4-8.4	9-20	0-4
	55-60	20-34	20.0-29.0	7.4-8.4	9-20	0-4
421B: Ves-----	0-10	20-30	14.0-27.0	6.1-7.8	4-12	---
	10-25	20-32	10.0-20.0	6.6-7.8	8-19	---
	25-60	20-32	10.0-18.0	7.4-8.4	5-30	---
423: Seaforth-----	0-9	20-30	16.0-27.0	7.4-8.4	5-20	---
	9-21	20-30	10.0-19.0	7.4-8.4	18-30	---
	21-60	20-27	10.0-18.0	7.4-8.4	10-25	---
434: Perella-----	0-16	20-39	---	6.6-7.8	---	---
	16-25	18-34	---	6.6-7.8	---	---
	25-60	18-34	---	7.4-8.4	---	---
437F: Buse-----	0-7	18-27	13.0-18.0	6.6-8.4	0-25	---
	7-60	18-27	10.0-15.0	7.4-8.4	12-30	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
446: Normania-----	0-14	27-32	19.0-35.0	6.1-7.3	---	---
	14-23	22-32	10.0-21.0	6.6-7.8	---	---
	23-60	22-32	9.0-20.0	7.4-8.4	8-25	---
450: Rauville-----	0-42	27-35	---	7.4-8.4	---	0-2
	42-60	20-35	---	7.4-8.4	---	0-4
494B: Darnen-----	0-26	18-27	---	6.6-7.8	---	---
	26-44	18-30	---	6.1-7.8	---	---
	44-60	18-30	---	7.4-8.4	---	---
497: Hantho-----	0-10	10-27	14.0-34.0	6.6-7.8	---	---
	10-22	10-18	10.0-22.0	6.6-7.8	---	---
	22-60	10-18	6.0-16.0	7.4-8.4	5-20	---
509: Vallers-----	0-13	28-35	15.0-28.0	7.4-8.4	12-25	0-4
	13-19	18-35	10.0-18.0	7.4-8.4	20-35	0-4
	19-60	18-35	8.0-16.0	7.4-8.4	12-25	0-4
574: Du Page-----	0-46	18-27	17.0-26.0	6.6-8.4	0-10	---
	46-60	18-27	11.0-18.0	7.4-8.4	5-20	---
597: Tara-----	0-10	18-27	15.0-32.0	6.1-7.3	---	---
	10-25	18-27	8.0-20.0	6.6-7.8	0-10	---
	25-36	18-27	8.0-20.0	7.4-8.4	10-25	---
	36-60	18-30	7.0-18.0	7.4-8.4	10-25	---
610: Calco-----	0-41	28-33	36.0-41.0	7.4-8.4	5-30	---
	41-46	30-35	36.0-41.0	7.4-8.4	5-30	---
	46-60	22-32	36.0-41.0	7.4-8.4	5-30	---
680: Parnell-----	0-17	27-40	---	6.1-7.8	---	---
	17-39	35-60	---	6.1-7.8	---	---
	39-60	22-40	---	6.6-8.4	---	---
694C2: Zell-----	0-7	10-18	15.0-25.0	6.6-8.4	0-5	0-2
	7-11	10-18	10.0-20.0	7.4-8.4	10-20	0-2
	11-60	5-18	10.0-20.0	7.4-8.4	10-15	0-2
706: Bigstone-----	0-11	28-35	26.0-48.0	7.4-8.4	0-20	---
	11-30	20-35	14.0-26.0	7.4-8.4	5-30	---
	30-60	20-32	12.0-18.0	7.4-8.4	5-30	---
724: Bigstone-----	0-9	28-35	26.0-48.0	7.4-8.4	0-20	---
	9-54	20-35	14.0-26.0	7.4-8.4	5-30	---
	54-60	20-32	12.0-18.0	7.4-8.4	5-30	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
<b>741B:</b>						
Poinsett-----	0-9	27-30	19.0-29.0	6.1-7.3	---	0-2
	9-17	20-32	14.0-24.0	6.1-7.8	0-3	0-2
	17-60	20-32	12.0-22.0	7.4-8.4	10-30	0-2
Buse-----	0-9	18-27	13.0-18.0	6.6-8.4	0-25	---
	9-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>748B:</b>						
Hamlet-----	0-10	18-26	---	6.6-7.3	---	---
	10-38	18-35	---	6.6-7.8	---	---
	38-60	18-35	---	7.9-8.4	---	---
<b>769A:</b>						
Mehurin-----	0-9	27-35	25.0-30.0	6.1-7.3	---	0-2
	9-14	35-60	25.0-30.0	6.1-7.8	0-10	0-2
	14-21	20-35	20.0-25.0	7.4-8.4	10-25	0-2
	21-60	20-30	15.0-25.0	7.4-8.4	5-20	0-2
<b>769B:</b>						
Mehurin-----	0-8	27-35	25.0-30.0	6.1-7.3	---	0-2
	8-17	35-60	25.0-30.0	6.1-7.8	0-10	0-2
	17-30	20-35	20.0-25.0	7.4-8.4	10-25	0-2
	30-60	20-30	15.0-25.0	7.4-8.4	5-20	0-2
<b>774:</b>						
Svea-----	0-10	18-26	---	6.1-7.8	---	---
	10-23	18-28	---	6.6-7.8	---	---
	23-60	18-28	---	7.4-8.4	---	---
<b>777C2:</b>						
Sisseton-----	0-6	15-20	25.0-35.0	7.4-8.4	0-5	0-2
	6-24	10-18	20.0-30.0	7.4-8.4	15-35	0-2
	24-60	10-18	20.0-30.0	7.4-8.4	7-30	0-2
Heimdal-----	0-8	10-20	10.0-24.0	6.1-7.3	---	---
	8-26	10-18	5.0-12.0	6.1-7.8	0-10	---
	26-47	10-18	5.0-12.0	7.4-8.4	20-30	---
	47-60	7-18	4.0-10.0	7.4-8.4	15-25	---
<b>883:</b>						
Du Page-----	0-38	18-27	17.0-26.0	6.6-8.4	0-10	---
	38-60	18-27	11.0-18.0	7.4-8.4	5-20	---
Zumbro-----	0-9	5-18	7.0-17.0	5.6-7.8	0-5	---
	9-32	2-10	3.0-13.0	5.6-7.8	0-5	---
	32-47	0-10	0.0-9.0	6.1-7.8	1-5	---
	47-60	0-5	0.0-7.0	6.1-7.8	1-5	---
<b>891B:</b>						
Doland-----	0-10	18-27	---	6.1-7.3	---	---
	10-28	18-27	---	6.1-7.3	---	---
	28-60	18-30	---	6.6-8.4	---	---
Buse-----	0-8	18-27	13.0-18.0	6.6-8.4	0-25	---
	8-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>902B:</b>						
Barnes-----	0-10	18-27	11.0-26.0	6.1-7.8	---	0-2
	10-21	18-27	8.0-18.0	6.1-7.8	0-5	0-2
	21-60	18-27	7.0-17.0	7.4-8.4	10-30	0-4

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
<b>902B:</b>						
<b>Buse</b> -----	0-8	18-27	13.0-18.0	6.6-8.4	0-25	---
	8-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>915C2:</b>						
<b>Buse</b> -----	0-7	18-27	---	6.6-8.4	0-25	---
	7-60	18-35	---	7.4-8.4	12-30	---
<b>Forman</b> -----	0-9	27-30	---	6.6-7.8	---	0-2
	9-15	30-35	---	6.6-7.8	---	0-2
	15-60	18-35	---	7.4-8.4	---	0-4
<b>942C2:</b>						
<b>Langhei</b> -----	0-5	18-27	10.0-30.0	6.6-8.4	0-30	---
	5-23	18-32	10.0-25.0	7.9-8.4	20-35	---
	23-60	18-32	10.0-25.0	7.4-8.4	15-30	---
<b>Barnes</b> -----	0-9	18-27	11.0-26.0	6.1-7.8	---	0-2
	9-32	18-27	8.0-18.0	6.1-7.8	0-5	0-2
	32-60	18-27	7.0-17.0	7.4-8.4	10-30	0-4
<b>954B:</b>						
<b>Ves</b> -----	0-9	20-30	14.0-27.0	6.1-7.8	4-12	---
	9-21	20-32	10.0-20.0	6.6-7.8	8-19	---
	21-60	20-32	10.0-18.0	7.4-8.4	5-30	---
<b>Swanlake</b> -----	0-8	18-27	13.0-22.0	7.4-8.4	0-10	---
	8-60	18-30	9.0-19.0	7.4-8.4	10-25	---
<b>954C2:</b>						
<b>Storden</b> -----	0-5	18-27	11.0-18.0	7.4-8.4	5-25	---
	5-60	18-30	9.0-17.0	7.4-8.4	5-25	---
<b>Ves</b> -----	0-8	20-30	14.0-27.0	6.1-7.8	4-12	---
	8-22	20-32	10.0-20.0	6.6-7.8	8-19	---
	22-60	20-32	10.0-18.0	7.4-8.4	5-30	---
<b>969B:</b>						
<b>Zell</b> -----	0-9	10-18	15.0-25.0	6.6-8.4	0-5	0-2
	9-21	10-18	10.0-20.0	7.4-8.4	10-20	0-2
	21-60	5-18	10.0-20.0	7.4-8.4	10-15	0-2
<b>Rothsay</b> -----	0-9	10-18	10.0-20.0	6.6-7.3	0-5	---
	9-23	10-18	6.0-12.0	6.6-7.8	0-10	---
	23-60	5-18	5.0-10.0	7.4-8.4	5-20	---
<b>1013.</b>						
<b>Pits</b>						
<b>1030:</b>						
<b>Udorthents.</b>						
<b>Pits.</b>						
<b>1051:</b>						
<b>Glencoe</b> -----	0-45	27-35	---	6.1-7.8	---	---
	45-57	25-35	---	6.6-7.8	---	---
	57-60	22-32	---	7.4-7.8	---	---

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
<b>1106C:</b>						
Storden-----	0-5	18-27	11.0-18.0	7.4-8.4	5-25	---
	5-60	18-30	9.0-17.0	7.4-8.4	5-25	---
Hawick-----	0-9	2-10	1.0-10.0	6.1-7.8	0-10	---
	9-20	1-10	1.0-5.0	6.1-7.8	0-10	---
	20-60	1-5	1.0-5.0	7.4-8.4	5-15	---
Ves-----	0-8	20-30	14.0-27.0	6.1-7.8	4-12	---
	8-23	20-32	10.0-20.0	6.6-7.8	8-19	---
	23-60	20-32	10.0-18.0	7.4-8.4	5-30	---
<b>1107D:</b>						
Sisseton-----	0-5	15-20	25.0-35.0	7.4-8.4	0-5	0-2
	5-31	10-18	20.0-30.0	7.4-8.4	15-35	0-2
	31-60	10-18	20.0-30.0	7.4-8.4	7-30	0-2
Sioux-----	0-7	10-20	15.0-20.0	6.6-8.4	---	0-2
	7-29	10-20	15.0-20.0	7.4-8.4	0-15	0-2
	29-60	0-10	15.0-20.0	7.4-8.4	0-15	0-2
Heimdal-----	0-7	10-20	10.0-24.0	6.1-7.3	---	---
	7-21	10-18	5.0-12.0	6.1-7.8	0-10	---
	21-60	10-18	5.0-12.0	7.4-8.4	20-30	---
<b>1108:</b>						
Harps-----	0-16	25-27	36.0-41.0	7.9-8.4	20-30	---
	16-38	18-32	25.0-30.0	7.9-8.4	20-30	---
	38-60	20-30	20.0-25.0	7.4-8.4	20-30	---
Glencoe-----	0-10	27-35	---	6.1-7.8	---	---
	10-30	25-35	---	6.1-7.8	---	---
	30-57	25-35	---	6.6-7.8	---	---
	57-60	22-32	---	7.4-7.8	---	---
Seaforth-----	0-9	20-30	16.0-27.0	7.4-8.4	5-20	---
	9-30	20-30	10.0-19.0	7.4-8.4	18-30	---
	30-60	20-27	10.0-18.0	7.4-8.4	10-25	---
<b>1222:</b>						
Parle-----	0-9	27-40	19.0-40.0	6.6-8.4	1-14	0-2
	9-26	18-35	8.0-29.0	7.4-8.4	1-14	0-2
	26-34	18-35	5.0-23.0	7.4-8.4	2-21	0-2
	34-50	18-35	5.0-23.0	7.4-8.4	2-21	0-2
	50-60	2-15	1.0-10.0	7.4-8.4	1-10	0-2
<b>1233B:</b>						
Esmond-----	0-9	10-18	---	7.4-8.4	---	---
	9-60	7-18	---	7.4-8.4	---	---
Heimdal-----	0-9	10-20	10.0-24.0	6.1-7.3	---	---
	9-25	10-18	5.0-12.0	6.1-7.8	0-10	---
	25-60	10-18	5.0-12.0	7.4-8.4	20-30	---
<b>1266C:</b>						
Yellowbank-----	0-12	10-27	8.0-36.0	4.5-7.3	---	0-2
	12-16	5-20	3.0-18.0	4.5-7.8	---	0-2
	16-26	---	---	---	---	---
Rock outcrop.						

## CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Salinity
	In	Pct	meq/100g	pH	Pct	mmhos/cm
<b>1295B:</b>						
<b>Doland</b> -----	0-8	18-27	17.0-26.0	6.1-7.3	---	---
	8-23	18-30	9.0-15.0	6.1-7.3	---	---
	23-42	18-30	9.0-15.0	7.4-8.4	10-20	---
	42-60	18-30	9.0-15.0	7.4-8.4	8-12	---
<b>1296:</b>						
<b>Swenoda</b> -----	0-16	10-20	10.0-23.0	6.1-7.3	---	0-2
	16-21	10-18	8.0-14.0	6.6-7.8	0-3	0-2
	21-60	20-35	11.0-19.0	7.4-8.4	10-30	0-4
<b>1309C:</b>						
<b>Buse</b> -----	0-8	18-27	13.0-18.0	6.6-8.4	0-25	---
	8-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>Doland</b> -----	0-9	18-27	---	6.1-7.3	---	---
	9-18	18-27	---	6.1-7.3	---	---
	18-60	18-30	---	6.6-8.4	---	---
<b>1865C:</b>						
<b>Buse</b> -----	0-8	18-27	13.0-18.0	6.6-8.4	0-25	---
	8-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>Barnes</b> -----	0-15	18-27	11.0-26.0	6.1-7.8	---	0-2
	15-22	18-27	8.0-18.0	6.1-7.8	0-5	0-2
	22-60	18-27	7.0-17.0	7.4-8.4	10-30	0-4
<b>1865F:</b>						
<b>Buse</b> -----	0-7	18-27	13.0-18.0	6.6-8.4	0-25	---
	7-60	18-27	10.0-15.0	7.4-8.4	12-30	---
<b>1870:</b>						
<b>Burr</b> -----	0-9	30-40	26.0-48.0	7.4-8.4	5-15	---
	9-45	35-45	27.0-48.0	7.4-8.4	5-15	---
	45-60	27-45	16.0-38.0	7.4-8.4	5-15	---
<b>Calco</b> -----	0-30	28-33	36.0-41.0	7.4-8.4	5-30	---
	30-51	30-35	36.0-41.0	7.4-8.4	5-30	---
	51-60	22-32	36.0-41.0	7.4-8.4	5-30	---
<b>1938:</b>						
<b>Lakepark</b> -----	0-10	20-27	---	6.1-7.8	---	---
	10-26	20-35	---	6.1-7.8	---	---
	26-37	22-35	---	6.6-7.8	---	---
	37-60	22-35	---	7.4-8.4	---	---
<b>1994:</b>						
<b>Embden</b> -----	0-17	10-18	15.0-20.0	6.1-7.3	---	---
	17-60	10-18	5.0-20.0	6.6-7.8	---	---

## WATER FEATURES

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
31D2: Storden-----	B	None	---	---	>6.0	---	---
34: Parnell-----	C/D	None	---	---	+1.0-0.0	Apparent	Jan-Dec
47: Colvin-----	C/D	None	---	---	0.0-1.0	Apparent	Apr-Jul
51: La Prairie-----	B	Occasional	Brief	Mar-Jun	3.5-6.0	Apparent	Mar-Jun
60: Glyndon-----	B	None	---	---	1.5-3.0	Apparent	Apr-Jun
67: Bearden-----	C	None	---	---	2.0-4.0	Apparent	Apr-Jun
70: Svea-----	B	None	---	---	4.0-6.0	Apparent	Apr-Jun
85: Calco-----	B/D	Occasional	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
108: McIntosh-----	B	None	---	---	2.0-4.0	Apparent	Apr-Nov
113: Webster-----	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul
114: Glencoe-----	B/D	None	---	---	+1.0-0.0	Apparent	Oct-Jul
127A, 127B, 127C: Sverdrup-----	B	None	---	---	>6.0	---	---
137: Dovray-----	C/D	None	---	---	+2.0-0.0	Apparent	Jan-Dec
141A, 141B, 141C: Egeland-----	B	None	---	---	>6.0	---	---
168B: Forman-----	B	None	---	---	>6.0	---	---
184: Hamerly-----	C	None	---	---	2.0-4.0	Apparent	Apr-Jun
210: Fulda-----	C/D	None	---	---	1.0-3.0	Perched	Oct-Jun
212A: Sinai-----	C	None	---	---	3.5-5.0	Apparent	Mar-Jun
212B: Sinai-----	C	None	---	---	>6.0	---	---
219: Rolfe-----	C	None	---	---	+1.0-0.0	Apparent	Nov-Jul
220D2: Langhei-----	B	None	---	---	>6.0	---	---

## WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
236: Vallers-----	C	None	---	---	1.0-2.5	Apparent	Apr-Jun
246: Marysland-----	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul
276: Oldham-----	C/D	None	---	---	+1.0-0.0	Apparent	Oct-Jun
284B: Poinsett-----	B	None	---	---	>6.0	---	---
288F: Esmond-----	B	None	---	---	>6.0	---	---
290B: Rothsay-----	B	None	---	---	>6.0	---	---
293B: Svenoda-----	B	None	---	---	>6.0	---	---
314: Spottswood-----	B	None	---	---	3.0-5.0	Apparent	Oct-Jun
338: Waubay-----	B	None	---	---	3.5-5.0	Apparent	Oct-Jun
339: Fordville-----	B	None	---	---	>6.0	---	---
341A, 341B, 341C: Arvilla-----	B	None	---	---	>6.0	---	---
344: Quam-----	B/D	None	---	---	+2.0-0.0	Apparent	Jan-Dec
347: Malachy-----	B	None	---	---	3.0-5.0	Apparent	Nov-Apr
375: Forada-----	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun
396D2: Sisseton-----	B	None	---	---	>6.0	---	---
402F: Sioux-----	A	None	---	---	>6.0	---	---
418: Lamoure-----	C	Occasional	Brief	Mar-Oct	0.0-1.5	Apparent	Oct-Jun
421B: Ves-----	B	None	---	---	>6.0	---	---
423: Seaforth-----	B	None	---	---	3.0-6.0	Apparent	Mar-Jun
434: Perella-----	B	None	---	---	0.5-1.5	Apparent	May-Jun
437F: Buse-----	B	None	---	---	>6.0	---	---

## WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
					Ft		
446: Normania-----	B	None	---	---	2.5-6.0	Apparent	Mar-Jun
450: Rauville-----	D	Frequent	Brief	Mar-Oct	+1.0-0.0	Apparent	Jan-Dec
494B: Darnen-----	B	None	---	---	2.5-6.0	Apparent	Nov-Jun
497: Hantho-----	B	None	---	---	3.0-5.0	Apparent	Mar-Jun
509: Vallers-----	C	None	---	---	1.0-2.5	Apparent	Apr-Jun
574: Du Page-----	B	Occasional	Brief	Apr-Jun	4.0-6.0	Apparent	Feb-Jun
597: Tara-----	B	None	---	---	3.0-5.0	Perched	Mar-Jun
610: Calco-----	B/D	Frequent	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
680: Parnell-----	C/D	None	---	---	1.0-3.0	Apparent	Nov-Jun
694C2: Zell-----	B	None	---	---	>6.0	---	---
706: Bigstone-----	B/D	None	---	---	+3.0-0.0	Apparent	Jan-Dec
724: Bigstone-----	B/D	None	---	---	+1.0-0.0	Apparent	Mar-Jul
741B: Poinsett-----	B	None	---	---	>6.0	---	---
Buse-----	B	None	---	---	>6.0	---	---
748B: Hamlet-----	B	None	---	---	3.0-5.0	Apparent	Apr-Jun
769A, 769B: Mehurin-----	C	None	---	---	2.0-4.0	Apparent	Apr-Jun
774: Svea-----	B	None	---	---	4.0-6.0	Apparent	Apr-Jun
777C2: Sisseton-----	B	None	---	---	>6.0	---	---
Heimdall-----	B	None	---	---	>6.0	---	---
883: Du Page-----	B	Occasional	Brief	Apr-Jun	4.0-6.0	Apparent	Feb-Jun
Zumbro-----	A	Occasional	Brief	Apr-Jun	>6.0	---	---

## WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
891B: Doland-----	B	None	---	---	>6.0	---	---
Buse-----	B	None	---	---	>6.0	---	---
902B: Barnes-----	B	None	---	---	>6.0	---	---
Buse-----	B	None	---	---	>6.0	---	---
915C2: Buse-----	B	None	---	---	>6.0	---	---
Forman-----	B	None	---	---	>6.0	---	---
942C2: Langhei-----	B	None	---	---	>6.0	---	---
Barnes-----	B	None	---	---	>6.0	---	---
954B: Ves-----	B	None	---	---	>6.0	---	---
Swanlake-----	B	None	---	---	>6.0	---	---
954C2: Storden-----	B	None	---	---	>6.0	---	---
Ves-----	B	None	---	---	>6.0	---	---
969B: Zell-----	B	None	---	---	>6.0	---	---
Rothsay-----	B	None	---	---	>6.0	---	---
1013: Pits-----	---	None	---	---	>6.0	---	---
1030: Udorthents.  Pits.							
1051: Glencoe-----	D	None	---	---	+3.0-0.0	Apparent	Jan-Dec
1106C: Storden-----	B	None	---	---	>6.0	---	---
Hawick-----	A	None	---	---	>6.0	---	---
Ves-----	B	None	---	---	>6.0	---	---
1107D: Sisseton-----	B	None	---	---	>6.0	---	---
Sioux-----	A	None	---	---	>6.0	---	---
Heimdal-----	B	None	---	---	>6.0	---	---

## WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
					Ft		
1108: Harps-----	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun
Glencoe-----	B/D	None	---	---	+1.0-0.0	Apparent	Oct-Jul
Seaforth-----	B	None	---	---	3.0-6.0	Apparent	Mar-Jun
1222: Parle-----	C/D	None	---	---	0.5-1.5	Apparent	Mar-Jul
1233B: Esmond-----	B	None	---	---	>6.0	---	---
Heimdal-----	B	None	---	---	>6.0	---	---
1266C: Yellowbank-----	D	None	---	---	>6.0	---	---
Rock outcrop----	---	None	---	---	>6.0	---	---
1295B: Doland-----	B	None	---	---	4.0-6.0	Apparent	Mar-Jun
1296: Swenoda-----	B	None	---	---	2.5-4.0	Perched	Mar-Jun
1309C: Buse-----	B	None	---	---	>6.0	---	---
Doland-----	B	None	---	---	>6.0	---	---
1865C: Buse-----	B	None	---	---	>6.0	---	---
Barnes-----	B	None	---	---	>6.0	---	---
1865F: Buse-----	B	None	---	---	>6.0	---	---
1870: Burr-----	D	Occasional	---	Mar-Jun	1.0-3.0	Apparent	Mar-Jun
Calco-----	B/D	Occasional	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
1938: Lakepark-----	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun
1994: Embden-----	B	None	---	---	4.0-6.0	Apparent	Apr-Jun

## SOIL FEATURES

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	In				
31D2: Storden-----	>60	---	Moderate----	Low-----	Low.
34: Parnell-----	>60	---	High-----	High-----	Low.
47: Colvin-----	>60	---	High-----	High-----	Low.
51: La Prairie-----	>60	---	Moderate----	Moderate----	Low.
60: Glyndon-----	>60	---	High-----	High-----	Low.
67: Bearden-----	>60	---	High-----	High-----	Low.
70: Svea-----	>60	---	Moderate----	High-----	Low.
85: Calco-----	>60	---	High-----	High-----	Low.
108: McIntosh-----	>60	---	High-----	High-----	Low.
113: Webster-----	>60	---	High-----	High-----	Low.
114: Glencoe-----	>60	---	High-----	High-----	Low.
127A: Sverdrup-----	>60	---	Low-----	Low-----	Low.
127B: Sverdrup-----	>60	---	Low-----	Low-----	Low.
127C: Sverdrup-----	>60	---	Low-----	Low-----	Low.
137: Dovray-----	>60	---	Moderate----	High-----	Low.
141A: Egeland-----	>60	---	Low-----	Moderate----	Low.
141B: Egeland-----	>60	---	Low-----	Moderate----	Low.
141C: Egeland-----	>60	---	Low-----	Moderate----	Low.
168B: Forman-----	>60	---	Moderate----	High-----	Low.
184: Hamerly-----	>60	---	High-----	High-----	Low.
210: Fulda-----	>60	---	High-----	High-----	Low.

## SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	In				
212A: Sinai-----	>60	---	High-----	High-----	Low.
212B: Sinai-----	>60	---	Low-----	High-----	High.
219: Rolfe-----	>60	---	High-----	High-----	Moderate.
220D2: Langhei-----	>60	---	Moderate----	Low-----	Low.
236: Vallers-----	>80	---	High-----	High-----	Low.
246: Marysland-----	>60	---	High-----	High-----	Low.
276: Oldham-----	>60	---	High-----	Moderate----	High.
284B: Poinsett-----	>60	---	High-----	High-----	Low.
288F: Esmond-----	>60	---	Moderate----	High-----	Low.
290B: Rothsay-----	>60	---	High-----	Low-----	Low.
293B: Swenoda-----	>60	---	Moderate----	High-----	Moderate.
314: Spottswood-----	>60	---	Moderate----	High-----	Low.
338: Waubay-----	>60	---	High-----	High-----	Low.
339: Fordville-----	>60	---	Low-----	Moderate----	Low.
341A: Arvilla-----	>60	---	Low-----	Moderate----	Low.
341B: Arvilla-----	>60	---	Low-----	Moderate----	Low.
341C: Arvilla-----	>60	---	Low-----	Moderate----	Low.
344: Quam-----	>60	---	High-----	High-----	Low.
347: Malachy-----	>60	---	High-----	Low-----	Low.
375: Forada-----	>60	---	High-----	High-----	Low.
396D2: Sisseton-----	>60	---	Moderate----	High-----	Low.

## SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	In				
402F: Sioux-----	>60	---	Low-----	Low-----	Low.
418: Lamoure-----	>60	---	High-----	High-----	Moderate.
421B: Ves-----	>60	---	Moderate-----	Low-----	Low.
423: Seaforth-----	>60	---	High-----	High-----	Low.
434: Perella-----	>60	---	High-----	High-----	Low.
437F: Buse-----	>60	---	Moderate-----	Low-----	Low.
446: Normania-----	>60	---	High-----	High-----	Low.
450: Rauville-----	>60	---	High-----	High-----	Moderate.
494B: Darnen-----	>60	---	Moderate-----	High-----	Low.
497: Hantho-----	>60	---	High-----	Moderate-----	Low.
509: Vallers-----	>80	---	High-----	High-----	Low.
574: Du Page-----	>60	---	Moderate-----	Low-----	Low.
597: Tara-----	>60	---	High-----	Moderate-----	Low.
610: Calco-----	>60	---	High-----	High-----	Low.
680: Parnell-----	>60	---	High-----	High-----	Low.
694C2: Zell-----	>60	---	High-----	High-----	Moderate.
706: Bigstone-----	>60	---	High-----	High-----	Low.
724: Bigstone-----	>60	---	High-----	High-----	Low.
741B: Poinsett-----	>60	---	High-----	High-----	Low.
Buse-----	>60	---	Moderate-----	Low-----	Low.
748B: Hamlet-----	>60	---	High-----	High-----	Low.

## SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	In				
769A: Mehurin-----	>60	---	Moderate----	High-----	Low.
769B: Mehurin-----	>60	---	Moderate----	High-----	Low.
774: Svea-----	>60	---	Moderate----	High-----	Low.
777C2: Sisseton-----	>60	---	Moderate----	High-----	Low.
Heimdal-----	>60	---	Moderate----	High-----	Low.
883: Du Page-----	>60	---	Moderate----	Low-----	Low.
Zumbro-----	>60	---	Low-----	Low-----	Low.
891B: Doland-----	>60	---	Moderate----	Low-----	Low.
Buse-----	>60	---	Moderate----	Low-----	Low.
902B: Barnes-----	>60	---	Moderate----	Moderate----	Low.
Buse-----	>60	---	Moderate----	Low-----	Low.
915C2: Buse-----	>60	---	Moderate----	Low-----	Low.
Forman-----	>60	---	Moderate----	High-----	Low.
942C2: Langhei-----	>60	---	Moderate----	Low-----	Low.
Barnes-----	>60	---	Moderate----	Moderate----	Low.
954B: Ves-----	>60	---	Moderate----	Low-----	Low.
Swanlake-----	>60	---	Moderate----	Low-----	Low.
954C2: Storden-----	>60	---	Moderate----	Low-----	Low.
Ves-----	>60	---	Moderate----	Low-----	Low.
969B: Zell-----	>60	---	High-----	High-----	Moderate.
Rothsay-----	>60	---	High-----	Low-----	Low.
1013: Pits-----	0-4	Hard	None-----	---	---
1030: Udorthents. Pits.					

## SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	In				
1051: Glencoe-----	>60	---	High-----	High-----	Low.
1106C: Storden-----	>60	---	Moderate---	Low-----	Low.
Hawick-----	>60	---	Low-----	Low-----	Low.
Ves-----	>60	---	Moderate---	Low-----	Low.
1107D: Sisseton-----	>60	---	Moderate---	High-----	Low.
Sioux-----	>60	---	Low-----	Low-----	Low.
Heimdal-----	>60	---	Moderate---	High-----	Low.
1108: Harps-----	>60	---	High-----	High-----	Low.
Glencoe-----	>60	---	High-----	High-----	Low.
Seaforth-----	>60	---	High-----	High-----	Low.
1222: Parle-----	>60	---	High-----	High-----	Low.
1233B: Esmond-----	>60	---	Moderate---	High-----	Low.
Heimdal-----	>60	---	Moderate---	High-----	Low.
1266C: Yellowbank-----	10-30	Hard	Moderate---	Low-----	Low.
Rock outcrop---	0-4	Hard	---	---	---
1295B: Doland-----	>60	---	Moderate---	Low-----	Low.
1296: Swenoda-----	>60	---	Moderate---	High-----	Moderate.
1309C: Buse-----	>60	---	Moderate---	Low-----	Low.
Doland-----	>60	---	Moderate---	Low-----	Low.
1865C: Buse-----	>60	---	Moderate---	Low-----	Low.
Barnes-----	>60	---	Moderate---	Moderate---	Low.
1865F: Buse-----	>60	---	Moderate---	Low-----	Low.
1870: Burr-----	>60	---	High-----	High-----	Low.
Calco-----	>60	---	High-----	High-----	Low.

## SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Potential frost action	Risk of corrosion	
	Depth	Hardness		Uncoated steel	Concrete
	<u>In</u>				
1938: Lakepark-----	>60	---	High-----	High-----	Low.
1994: Embden-----	>60	---	Moderate---	High-----	Low.

# References

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- American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 vols.
- American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.
- Diedrick, R.T., and R.H. Rust. 1975. Glacial lake evidence in western Minnesota. *Soil Survey Journal of the Minnesota Academy of Science* 41: 9-12.
- Jenny, Hans. 1941. Factors of soil formation.
- Matsch, C.L. 1972. Quaternary geology of southwestern Minnesota. *In Geology of Minnesota*. Chapter VII, pp. 548-560.
- Matsch, C.L., and others. 1972. Field trip guide book for geomorphology and Quaternary stratigraphy of western Minnesota and eastern South Dakota. Geological Society of America, Minnesota Geological Survey.
- Mayer, L.R., and O.G. Dale. 1916. History of Chippewa and Lac qui Parle Counties, Minnesota. Vol. 1.
- Minnesota Agricultural Statistics Service. 1990. Minnesota agricultural statistics, 1989.
- United States Department of Agriculture. 1924. Soil survey of Lac qui Parle County, Minnesota. Bureau of Chemistry and Soils, series 1924, no. 23.
- United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.
- United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conservation Service, U.S. Department of Agriculture Handbook 436.
- United States Department of Agriculture. 1993. Soil survey manual. Soil Conservation Service, U.S. Department of Agriculture Handbook 18.
- Wright, H.E., and Robert V. Ruhe. 1965. The glaciation of Minnesota and Iowa. *International Association of Quaternary Research*, pp. 29-41.

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# Glossary

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**Ablation till.** Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Aquic conditions.** Current soil wetness characterized by saturation, reduction, and redoximorphic features.

**Area reclaim (in tables).** An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Argillic horizon.** A subsoil horizon characterized by an accumulation of illuvial clay.

**Aspect.** The direction in which a slope faces.

**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:

Very low .....	0 to 3
Low .....	3 to 6
Moderate .....	6 to 9
High .....	more than 9

**Back slope.** The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope. In terms of gradational process, back slopes

are erosional forms produced mainly by mass wasting and running water.

**Basal till.** Compact till deposited beneath the ice.

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

**Bedding planes.** Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bedrock-controlled topography.** A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

**Bench terrace.** A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

**Bisequum.** Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Brush management.** Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Canopy.** The leafy crown of trees or shrubs. (See Crown.)

- Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.
- Catena.** A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.
- Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.
- Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.
- Catsteps.** Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.
- Channery soil.** A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.
- Chemical treatment.** Control of unwanted vegetation through the use of chemicals.
- Chiseling.** Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Clay depletions.** Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.
- Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.
- Climax plant community.** The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.
- Coarse textured soil.** Sand or loamy sand.
- Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.
- Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.
- Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.
- Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.
- Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.
- Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.
- Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.
- Conservation tillage.** Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where wind erosion is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.
- Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:  
*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.  
*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.  
*Firm.*—When moist, crushes under moderate

pressure between thumb and forefinger, but resistance is distinctly noticeable.

**Plastic.**—Readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

**Sticky.**—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

**Hard.**—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

**Soft.**—When dry, breaks into powder or individual grains under very slight pressure.

**Contour stripcropping (or contour farming).** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Coprogenous earth (sedimentary peat).** Fecal material deposited in water by aquatic organisms.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cropping system.** Growing crops according to a planned system of rotation and management practices.

**Crop residue management.** Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

**Cross-slope farming.** Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

**Crown.** The upper part of a tree or shrub, including the living branches and their foliage.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Delta.** A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

**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 soils, 20 to 40 inches; shallow soils, 10 to 20 inches; and very shallow soils, less than 10 inches.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class (natural).** Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

**Excessively drained.**—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

**Somewhat excessively drained.**—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

**Well drained.**—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

**Moderately well drained.**—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

**Somewhat poorly drained.**—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

**Poorly drained.**—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

**Very poorly drained.**—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

**Duff.** A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Endosaturation.** A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Ephemeral stream.** A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

**Episaturation.** A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion (geologic).* Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion (accelerated).* Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

**Erosion pavement.** A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

**Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

**Esker.** A long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that were deposited by a subsurface stream flowing between ice walls or through ice tunnels of a retreating glacier and that were left behind when the ice melted. Eskers range from less than 1 mile

to more than 100 miles in length and from 10 to 100 feet in height.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Fan terrace.** A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

**Fine textured soil.** Sandy clay, silty clay, or clay.

**Firebreak.** An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of fire fighters and equipment. Designated roads also serve as firebreaks.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flaggy soil material.** Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.

**Flagstone.** A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

**Foot slope.** The geomorphic component that forms the inner, gently inclined surface at the base of a hill slope. The surface is dominantly concave. In terms of gradational processes, a foot slope is a transition zone between an upslope site of erosion (back slope) and a downslope site of deposition (toe slope).

**Forb.** Any herbaceous plant not a grass or a sedge.

**Forest cover.** All trees and other woody plants (underbrush) covering the ground in a forest.

**Forest type.** A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

**Fragipan.** A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

**Frost action (in tables).** Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial drift.** Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial outwash.** Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

**Glaciofluvial deposits.** Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

**Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

**Graded stripcropping.** Growing crops in strips that grade toward a protected waterway.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

**Green manure crop** (agronomy). A soil-improving crop

grown to be plowed under in an early stage of maturity or soon after maturity.

**Ground water.** Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Hard bedrock.** Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

**Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

**High-chroma zones.** Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

**High-residue crops.** Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

**Hill.** A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an A

horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon.*—Soft, consolidated bedrock beneath the soil.

*R layer.*—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Igneous rock.** Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration capacity.** The maximum rate at which water can infiltrate into a soil under a given set of conditions.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2 .....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low
0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5 .....	very high

**Intermittent stream.** A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

**Iron concentrations.** High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

**Iron depletions.** Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-

growing crops or in orchards so that it flows in only one direction.

**Drip (or trickle).**—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

**Furrow.**—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

**Sprinkler.**—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

**Subirrigation.**—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

**Wild flooding.**—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Kame.** A moundlike hill of glacial drift, composed chiefly of stratified sand and gravel.

**Karst (topography).** The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

**Knoll.** A small, low, rounded hill rising above adjacent landforms.

**Lacustrine deposit.** Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Landslide.** The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones (in tables).** 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.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low-chroma zones.** Zones having chroma of 2 or less. Typical color in areas of iron depletions.

**Low-residue crops.** Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

**Low strength.** The soil is not strong enough to support loads.

**Marl.** An earthy, unconsolidated deposit consisting

chiefly of calcium carbonate mixed with clay in approximately equal amounts.

**Masses.** Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

**Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.

**Mollic epipedon.** A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

**Moraine.** An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*,

more than 15 millimeters (about 0.6 inch).

**Muck.** Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

**Mudstone.** Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nodules.** Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low .....	less than 0.5 percent
Low .....	0.5 to 1.0 percent
Moderately low .....	1.0 to 2.0 percent
Moderate .....	2.0 to 4.0 percent
High .....	4.0 to 8.0 percent
Very high .....	more than 8.0 percent

**Outwash plain.** An extensive area of glaciofluvial material that was deposited by meltwater streams.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedisediment.** A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The movement of water through the soil.

**Percs slowly (in tables).** The slow movement of water through the soil adversely affects the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile.

Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow .....	less than 0.06 inch
Slow .....	0.06 to 0.2 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping (in tables).** Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Plateau.** An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**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 (in tables).** Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Potential native plant community.** See Climax plant community.

**Potential rooting depth (effective rooting depth).**

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

**Prescribed burning.** Burning an area under conditions of weather and soil moisture and at the time of day that will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid . . . . .	less than 4.5
Very strongly acid . . . . .	4.5 to 5.0
Strongly acid . . . . .	5.1 to 5.5
Moderately acid . . . . .	5.6 to 6.0
Slightly acid . . . . .	6.1 to 6.5
Neutral . . . . .	6.6 to 7.3
Slightly alkaline . . . . .	7.4 to 7.8
Moderately alkaline . . . . .	7.9 to 8.4
Strongly alkaline . . . . .	8.5 to 9.0
Very strongly alkaline . . . . .	9.1 and higher

**Redoximorphic concentrations.** Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

**Redoximorphic depletions.** Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

**Redoximorphic features.** Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

**Reduced matrix.** A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Road cut.** A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth (in tables).** Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Root zone.** The part of the soil that can be penetrated by plant 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.

**Saline soil.** A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-sized particles.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**Saprolite.** Unconsolidated residual material underlying the soil and grading to hard bedrock below.

**Saturation.** Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

**Scarification.** The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

**Second bottom.** The first terrace above the normal flood plain (or first bottom) of a river.

**Sedimentary rock.** Rock made up of particles

deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

- Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.
- Sequum.** A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)
- Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.
- Shale.** Sedimentary rock formed by the hardening of a clay deposit.
- Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.
- Shrink-swell** (in tables). 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.
- Silica.** A combination of silicon and oxygen. The mineral form is called quartz.
- Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.
- Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.
- Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.
- Sinkhole.** A depression in the landscape where limestone has been dissolved.
- Site index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.
- Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks,

prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

- Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
- Sloughed till.** Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.
- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.
- Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.
- Soft bedrock.** Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.
- Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.
- Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:
 

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002
- Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.
- Stone line.** A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by

recent sediment of variable thickness.

- Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.
- Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.
- Stripcropping.** Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.
- Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).
- Stubble mulch.** Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.
- Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.
- Subsoiling.** Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.
- Substratum.** The part of the soil below the solum.
- Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.
- Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."
- Surface soil.** The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.
- Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.
- Terminal moraine.** A belt of thick glacial drift that generally marks the termination of important glacial advances. It commonly is a massive, arcuate ridge or complex of ridges underlain by till and other types of drift.

- Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.
- Terrace (geologic).** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.
- Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."
- Thin layer (in tables).** Otherwise suitable soil material too thin for the specified use.
- Till.** Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
- Till plain.** An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.
- Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.
- Toe slope.** The outermost inclined surface at the base of a hill. Toe slopes are commonly gentle and linear in profile.
- Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.
- Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.
- Upland (geology).** Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.
- Valley fill.** In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.
- Variation.** Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.
- Varve.** A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded

glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

**Water bars.** Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

**Windthrow.** The uprooting and tipping over of trees by the wind.



# Accessibility Statement

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