WILLAMETTE NATIONAL FOREST

SOIL RESOURCE INVENTORY

Pacific Northwest Region

June 1973

Prepared by

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Soil Scientists

PREFACE

This Soil Resource Inventory of the Willamette National Forest was made to provide some basic soil, bedrock and landform information for management interpretations. The inventory is part of the Regional soils program developed by the Soil Management Branch of the Division of Watershed Management to assist forest land managers in applying multiple use principles.

The objective of this Soil Resource Inventory is to provide soils information in a form useful to the land manager as an aid to multiple use management as directed by Public Law 86-517. This law states that the National Forests are to be administered to achieve and maintain in perpetuity a high level of annual or regular periodic output of the various renewable resources of the National Forests without impairment of the productivity of the land.

All renewable surface resources of the National Forest are dependent upon soil, which is a nonrenewable resource. Soils develop at a slow rate, about one inch every thousand years in residual soils developing from rock. Soils developing from glacial outwash and till, alluvium, loess, and colluvium proceed at a faster rate. "A" horizons develop much faster and "B" horizons at a somewhat slower rate than residual soils. This fact necessitates conservation, wise use, and in many instances, preservation of this basic resource in order to produce high-level, sustained yields of water, timber, recreation, wildlife, and forage. To accomplish sustained yield of renewable resources, to conserve or preserve the soil resource while making wise use of this resource, it is necessary to have basic soils information and to make sound management interpretations.

This report contains information on climate, soils, geology, landform features, and some management interpretations. Under separate cover is an Atlas of soil maps showing location and extent of the various soils, Tables of Management Interpretations, Table of Soil Characteristics of Modal Site, Table of Some Mapping Unit Characteristics, Features and Qualities, and Table of Bedrock Characteristics.

Field mapping was conducted from November 1971 through December 1972 by Soil Scientists Harold A. Legard and LeRoy C. Meyer. Supervision was provided by Loren Herman.

During the course of the survey, valuable assistance, advice, and cooperation received from Forest personnel was sincerely appreciated.

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USE

Land management activities generally relate to the soil resource. Timber harvest, road construction, recreation development, and many other activities have an effect on the soil resource to some degree. It is extremely important for the land manager to thoroughly understand the effect of the various activities on the soil. It is equally important for the land manager to fully understand the capabilities of the soil resource. Basic soils information contained in this report will help the land managers and planners to (1) determine the effects of management on the soil and water resource, and (2) evaluate the capabilities of the soil for various uses.

The information in this report is presented in two levels. The first is the Mapping Unit level and is the basic level of soil identification and management interpretation used in the report. The mapping unit is derived and defined on the basis of its soil, landform, geology, and vegetation characteristics. The average delineation size is 50 to 600 acres.

At this level, management problems related to the landform and soil are easily defined and interpretations have been made. This information has been tabulated and can be found within the Appendix of this report, or in the Atlas along with the soil maps.

The second level of presentation is the generalized land areas and is a broader level than just described. The land areas each contain several mapping units that have similar soil and topographic characteristics. Certain management problems and uses of these mapping units are similar and are discussed as a group. The land areas then enable the user to become quickly familiar with general problems occurring throughout large areas.

The Soil Resource Inventory (SRI) has its primary use at the planning level. Soils, landforms, and bedrock characteristics are defined at an intensity sufficient to help develop resource management policies and basic plans. Due to the reconnaissance nature of this survey, it lacks detail for use in high-intensity, small-area projects. These projects require additional onsite study by various technical specialists, including soil scientists.

There are many uses for the information in this report. Some are quite simple and apparent, while others have not yet been conceived. The real work lies ahead in effectively and fully using this information. The use of this information is achieved best by those with full understanding of the interrelationships of the basic earth features.

Examples of how SRI information can be used are listed below:

1. Transportation Planning - This is an area where the soils information has key application. Conditions and problems can be met or avoided

based on information such as landscape stability, soil depth, soil drainage and/or bedrock type and competency. Roads may be selected that avoid unstable areas, and construction and maintenance costs may be more accurately estimated. Sources of road rock may also be located through use of soil maps. SRI information is available for assistance in road design such as cutbank ratios and road rock thickness.

2. Recreation Planning - The SRI information indicates the various soil suitabilities and limitations that may apply to ski areas, camping areas, trails, roads, and other aspects of recreation development. By knowing the soil suitabilities and limitations, the planner is better able to make plans that are consistent with the capabilities of the land.

3. Multiple Use Plans - The soils information in this report should be incorporated into the multiple use plans. As an example of application, the soil areas in this report can provide a map to show the critical soil areas and their associated problems. These problems are discussed for individual soils and land areas. This is the kind of information that will support the policy and directives, and assist in multiple use. Another example of use would be to color the maps in the Atlas to illustrate various soil management relationships. For instance, the maps can be colored to show stability, erosion, site index, etc.

4. 5-Year Action Plan - This report provides information on the relative susceptibility of soil and other resource damage from timber harvest, road construction, and other timber-related activities. Provided also, is information on regeneration problems and erosion control requirements.

5. Timber Management Plan - The soils information can suggest direction and support policy for allowable cut determinations, logging systems, slash disposal methods, operating season, and deferred cutting areas. With a better understanding of problems and their location, the cut can be planned so that at a given time the majority of cutting is not taking place in critical areas. By spreading out and deferring the more critical areas, more time is available for proper road location and design on these areas. Also, within a few years, logging technology may have developed so that harvest methods are compatible with critical soil areas without causing excessive soil and resource damage.

6. Impact Reports - Any report involving the impact of a management activity requires soils input. Whether it is a ski area, recreation, or damsite proposal, there are soil factors that must be considered to make the report complete.

7. Land Appraisal and Exchange - Soils information should be used for land appraisal and exchange activities. The value of the land is related to such soil factors as texture, depth, drainage, productivity, and stability. Without knowledge of these and other soil factors, how can land value be appraised?

8. Multiple Use Survey Reports - Any MUS study can find the basic soils data in the SRI. However, additional interpretations may be needed for more specific information concerning soils and their behavior.

9. The following is a list of more specific uses of the report. These uses are adaptable and compatible with the survey data and are well within the scope and intensity of the survey:

   a. Engineering Testing - By using the soil maps, more efficient testing can be done. The soil maps can be used to determine which soils are most susceptible to certain engineering problems. These problem soils may need more closely spaced testing than soils in which few problems are anticipated.

   b. Reservoir Sites - This report gives information that can be used to determine problems that may be encountered for a reservoir site. The soil interpretations will enable the planner to better determine the general suitability of a particular site and the soil stability as they affect reservoir uses.

   c. Hydrologic Analysis - The information in the SRI is sufficient to determine a broad hydrologic analysis and water balance on the Forest, and as a basis for comparisons between larger watersheds.

   d. Multiple Discipline Teams - Under the concept of MDT, where a number of specialists coordinate on a management problem through team effort, the soils report will supply essential background information. It will give the team basic soils information on the uses, limitations, and hazards of soils as they relate to resource management.

   e. Timber Harvest Methods - Additional facts known about the potential for erosion and landscape stability will encourage selection of timber harvest methods that cause minimum damage to soil and other resources.

   f. Timber Harvest and Road Construction Operating Season - These activities should be scheduled at times when they will cause minimum soil damage. Many soils are subject to damage (compaction, erosion, site deterioration) by timber harvest activities when overly wet or excessively dry.

   g. Erosion Control - Since there is wide variability in soil texture, depth, structure, permeability, drainage, and topography, wide differences also occur in the ability of the soil to resist erosion. Forest soils are rated as to their potential erosion class. The land manager can use this information to determine which areas will need special erosion protective measures. These will need to be developed on a site-by-site basis.

h. Recreational Developments - Several kinds of information are available in this report to assist in selecting favorable sites for campground development. Among these are soil and landform properties and characteristics, specific ratings of filter drainage field suitability, the relative resistance of soil and vegetation to site deterioration, and indications of special problems which may be encountered.

DEFINITIONS OF MAPPING UNITS

This section defines the numbers and symbols found on the soil maps. The numbers identify mapping units. The symbols represent land features important to land management that are too small to delineate at the scale used for this survey. An exception is the dashed line used to delineate recently active or active slumps and unstable areas. The symbols used in this survey are listed below:

Rock outcrop

Talus

Unstable area

Wet spot and small marshes

Slump or slide scarp

Slump or unstable area

Modal site location

Sample location

Avalanche or debris slide track

Mapping Units 1/ are shown on the landtype maps as numbers. Mapping units contain a dominant landtype which accounts for at least 70 percent of the landtype delineation.

The dominant landtype of the mapping unit is described in the mapping unit description and identified by the same number as used for the mapping unit. Within the mapping unit other landtypes occur. Those most commonly associated with the dominant landtype of the mapping unit are included in the descriptions as inclusions. These inclusions of other landtypes account for no more than 30 percent of the mapping unit.

The management interpretations presented in the Atlas apply only to the dominant landtype in each mapping unit. The interpretations for most inclusions within any mapping unit are listed on the interpretative tables according to the appropriate landtype number. The Tables of Some Mapping Unit Characteristics, Features and Qualities, and Table of Bedrock Characteristics of Mapping Units are also numbered according to the dominant landtype in the mapping unit and apply to that dominant landtype.

1/ Mapping units contain a dominant taxonomic unit.

Mapping Unit Complexes

Many symbols shown on the maps have three digits and are called "Mapping Unit Complexes." These are mapping units used in areas where two or more defined mapping units are present in an arrangement too complex to separate at the one-inch per mile scale. The Legend of Complexes indicates the mapping unit components of the complex and the approximate percentage of each component.

Mapping Unit Descriptions

Most of the Mapping Units are described in detail. These landtypes have a definable range of characteristics that can be represented by a soil profile description. Mapping Units 0 through 9 are miscellaneous landtypes, quite variable, and not described in detail. They are described in a short narrative.

Information in Mapping Unit Descriptions

The first paragraph states the primary soil and the most common inclusions found within the Mapping Unit. The second paragraph gives a brief generalized description of the primary soil. The third paragraph briefly describes the bedrock occurring in the Mapping Unit. The fourth paragraph describes the landform and slope. The fifth paragraph describes the elevation and timber type. The sixth paragraph describes the drainage class and permeability rates. Reference should be made to Appendix VI for definitions of terms used in these descriptions.

Range of Profile Characteristics

This describes the range of soil profile characteristics that have been established for the dominant landtype within the mapping unit.

LEGEND OF COMPLEXES

Mapping Unit Number	Mapping Unit Components
132	60 percent Unit 13 and 40 percent Unit 23
133	60 percent Unit 13 and 40 percent Unit 33
134	70 percent Unit 13 and 30 percent Unit 44
135	50 percent Unit 13 and 50 percent Unit 55
137	70 percent Unit 13 and 30 percent Unit 64
142	60 percent Unit 14 and 40 percent Unit 23
143	70 percent Unit 14 and 30 percent Unit 33
145	60 percent Unit 14 and 40 percent Unit 25
157	50 percent Unit 16 and 50 percent Unit 57
161	60 percent Unit 16 and 40 percent Unit 61 1/
162	60 percent Unit 16 and 40 percent Unit 23
163	60 percent Unit 16 and 40 percent Unit 33
164	60 percent Unit 16 and 40 percent Unit 44
165	70 percent Unit 16 and 30 percent Unit 25
166	70 percent Unit 16 and 30 percent Unit 35
167	60 percent Unit 16 and 40 percent Unit 64
168	60 percent Unit 16 and 40 percent Unit 21 2/
169	50 percent Unit 16 and 50 percent Unit 56
194	70 percent Unit 19 and 30 percent Unit 44
195	60 percent Unit 19 and 40 percent Unit 55

1/ Minor amounts of Landtype Units 21 and 31 may also be present.

2/ Minor amounts of Landtype Units 61 and 31 may also be present.

Mapping Unit Number	Mapping Unit Components
201	60 percent Unit 21 and 40 percent Unit 31
202	60 percent Unit 21 and 40 percent Unit 61
203	40 percent Unit 21, 30 percent Unit 31, and 30 percent Unit 61
204	40 percent Unit 21, 30 percent Unit 31, and 30 percent Unit 2
210	60 percent Unit 21 and 40 percent Unit 2
212	60 percent Unit 21 and 40 percent Unit 23
213	70 percent Unit 21 and 30 percent Unit 33
214	60 percent Unit 21 and 40 percent Unit 44
215	40 percent Unit 21, 30 percent Unit 23, and 30 percent Unit 61
216	60 percent Unit 21 and 40 percent Unit 16
225	60 percent Unit 22 and 40 percent Unit 25
231	60 percent Unit 23 and 40 percent Unit 21
232	60 percent Unit 23 and 40 percent Unit 61
233	60 percent Unit 23 and 40 percent Unit 33
234	70 percent Unit 23 and 30 percent Unit 64
235	60 percent Unit 23 and 40 percent Unit 25
236	60 percent Unit 23 and 40 percent Unit 16
237	40 percent Unit 23, 30 percent Unit 33, and 30 percent Unit 21
238	60 percent Unit 23 and 40 percent Unit 56
251	60 percent Unit 25 and 40 percent Unit 21
252	60 percent Unit 25 and 40 percent Unit 13

Mapping Unit Number	Mapping Unit Components
253	60 percent Unit 25 and 40 percent Unit 23
254	60 percent Unit 25 and 40 percent Unit 14
255	60 percent Unit 25 and 40 percent Unit 35
256	60 percent Unit 25 and 40 percent Unit 16
261	40 percent Unit 23, 30 percent Unit 16, and 30 percent Unit 61
301	60 percent Unit 31 and 40 percent Unit 21
302	60 percent Unit 31 and 40 percent Unit 61
303	40 percent Unit 31, 30 percent Unit 21, and 30 percent Unit 61
304	40 percent Unit 31, 30 percent Unit 21, and 30 percent Unit 44
305	40 percent Unit 31, 30 percent Unit 61, and 30 percent Unit 33
310	60 percent Unit 31 and 40 percent Unit 2
313	60 percent Unit 31 and 40 percent Unit 33
331	60 percent Unit 33 and 40 percent Unit 31
332	50 percent Unit 33, 25 percent Unit 31, and 25 percent Unit 21
333	60 percent Unit 33 and 40 percent Unit 23
334	60 percent Unit 33 and 40 percent Unit 25
335	60 percent Unit 33 and 40 percent Unit 35
336	60 percent Unit 33 and 40 percent Unit 16
337	70 percent Unit 33 and 30 percent Unit 61
353	60 percent Unit 35 and 40 percent Unit 33
356	60 percent Unit 35 and 40 percent Unit 16

Mapping Unit Number	Mapping Unit Components
441	60 percent Unit 44 and 40 percent Unit 21
443	50 percent Unit 44 and 50 percent Unit 33
444	60 percent Unit 44 and 40 percent Unit 64
446	60 percent Unit 44 and 40 percent Unit 16
447	40 percent Unit 44, 30 percent Unit 64, and 30 percent Unit 16
553	60 percent Unit 55 and 40 percent Unit 13
554	70 percent Unit 55 and 30 percent Unit 44
559	60 percent Unit 55 and 40 percent Unit 19
563	70 percent Unit 56 and 30 percent Unit 33
564	60 percent Unit 56 and 40 percent Unit 54
601	70 percent Unit 61 and 30 percent Unit 31
602	60 percent Unit 61 and 40 percent Unit 21
603	40 percent Unit 61, 30 percent Unit 21, and 30 percent Unit 31
604	40 percent Unit 61, 30 percent Unit 31, and 30 percent Unit 33
605	40 percent Unit 61, 30 percent Unit 21, and 30 percent Unit 44
606	40 percent Unit 61, 30 percent Unit 31, and 30 percent Unit 64
607	60 percent Unit 61 and 40 percent Unit 54
608	60 percent Unit 61 and 40 percent Unit 57
610	60 percent Unit 61 and 40 percent Unit 1
614	60 percent Unit 61 and 40 percent Unit 64
615	60 percent Unit 61 and 40 percent Unit 44

Mapping Unit Number	Mapping Unit Components
616	60 percent Unit 61 and 40 percent Unit 16
617	50 percent Unit 61, 25 percent Unit 33, and 25 percent Unit 16
633	70 percent Unit 63 and 30 percent Unit 33
641	60 percent Unit 64 and 40 percent Unit 61
644	60 percent Unit 64 and 40 percent Unit 44
646	60 percent Unit 64 and 40 percent Unit 16
710	60 percent Unit 71 and 40 percent Unit 1
714	60 percent Unit 71 anc 40 percent Unit 74
731	70 percent Unit 73 and 30 percent Unit 1
736	70 percent Unit 73 and 30 percent Unit 6
737	70 percent Unit 73 and 30 percent Unit 7
740	70 percent Unit 74 and 30 percent Unit 1
741	60 percent Unit 74 and 40 percent Unit 71
812	70 percent Unit 81 and 30 percent Unit 82
821	60 percent Unit 82 and 40 percent Unit 81
825	70 percent Unit 82 and 30 percent Unit 85
852	70 percent Unit 85 and 30 percent Unit 82
910	60 percent Unit 91 and 40 percent Unit 1
914	60 percent Unit 91 and 40 percent Unit 94
920	60 percent Unit 92 and 40 percent Unit 1
923	60 percent Unit 92 and 40 percent Unit 93
924	60 percent Unit 92 and 40 percent Unit 94
926	70 percent Unit 92 and 30 percent Unit 6
932	60 percent Unit 93 and 40 percent Unit 92

Mapping Unit Number	Mapping Unit Components
940	70 percent Unit 94 and 30 percent Unit 1
941	60 percent Unit 94 and 40 percent Unit 91
942	60 percent Unit 94 and 40 percent Unit 92
954	60 percent Unit 95 and 40 percent Unit 54

MAPPING UNIT DESCRIPTIONS 1/

0 - Perpetual Snow, Ice, Rock Outcrop, and Talus

Areas near or above timberline on glaciated peaks of the High Cascades. This mapping unit is highly variable and is found on slopes ranging from 30% to greater than 100%. Bedrock materials consist of andesites, basalts, breccias, and various types of pyroclastic materials. All areas have been influenced by glacial activity. Vegetation consists of lichens, sedges, and a few hardy trees and shrubs near timberline.

1 - Rock Outcrop, Andesites and Basalts

Hard, fresh andesite and basalt rock outcrops commonly forming cliffs and "rock knobs." This mapping unit is usually associated with volcanic dikes, vents, and plugs. Minor amounts of various volcanic materials or sediments may be present. Material from this mapping unit is well suited for road rock. This mapping unit is an inclusion in mapping unit 3 when its lateral extent becomes so small that it is impractical to map separately.

2 - Rock Outcrop, Volcanic Breccias and Tuffs

Volcanic breccias, tuffs, agglomerates, conglomerates; clastic and pryoclastic sediments generally more easily weathered than mapping unit 1. Typically, outcrops are massive with few fractures. Bedding planes are often present with minor dikes and flows of andesite or basalt. Locally, these materials have been altered by hydrothermal and volcanic activity to extremely hard and resistant materials that stand out as "hoodoos."

1/ Mapping units 0 through 9 are miscellaneous landtypes and are not described in detail.

above the forest canopy. Outcrops of mapping unit 2 often support grasses and forbs locally. Generally, materials from this mapping unit are not as well suited for road rock as mapping unit 1. This mapping unit is an inclusion in mapping unit 3 when its lateral extent becomes so small that it is impractical to map separately.

3 - Talus, Rock Outcrop, Avalanche Chutes, and Low-Site Timber

This mapping unit is a complex of various kinds of rock outcrop, talus, and soils highly variable in depth, rock content, and moisture status. This mapping unit is generally found along upper sideslopes, ridgetops, and in areas of cirque topography. Timber found on this mapping unit is of low quality and quantity. Mapping units 1, 2, 6 & 7 are inclusions in this mapping unit when they become too small to map separately. Severe management problems occur within this mapping unit because of soil, climatic, and topographic limitations.

4 - Recent Volcanic Lava Flows

Fresh, recent volcanic lava flows of the High Cascades. Vegetation is sparse and found in pockets of soil material on the lava flows. Slopes are generally less than 30%.

5 - Cinder Cones

Recent cinder cones of the High Cascades having slight or no glacial modification. Soils are very cindery, sandy loams developing on volcanic ejecta making up the cinder cones. Vegetation consists of lodgepole pine, Douglas-fir, and true fir, mountain hemlock tree species. Slopes range from 40% to greater than 80%. The soil and parent material on these cinder cones tend to be loose and unconsolidated and ravel and erode severely when disturbed.

6 - Wet Non-Forest Land

Areas that have high water tables or become seasonally ponded. This mapping unit is highly variable in topographic position and is found in depressions, along streamside areas, and steep sideslopes. Boulder fields are often found within this unit on steep slopes. Vegetation consists of sedges, rushes, grasses, tag alder, devil's club, and willow. This mapping unit is an inclusion in mapping unit 3 when its lateral extent becomes so small that it is impractical to map separately.

7 - Dry Non-Forest Land

Dry non-forested areas supporting various grasses, forbs, sedges, and shrubs. These areas are usually found in the Upper Forest Zone and upper limits of the Principal Forest Zone along ridge lines and areas of cirque topography. Soils are shallow to moderately deep and contain less than 30% rock outcrop visible on the mapping photos. Often this mapping unit is an inclusion in mapping unit 3 when its lateral extent becomes so small it is impractical to map by itself. Small patches of low quality timber may be included in this mapping unit.

8 - Steep Dissected Landforms from Volcanic Breccias and Tuffs

Steep dissected land forms developing on green and red breccias and tuffs. Soil materials consist of residuum and colluvium and may range from less than one foot deep along ridge tops to more than 20 feet deep along drainages. Soil drainage, texture, coarse fragment content, and depth are highly variable. Occasional dikes and sills of andesite and basalt may occur. Douglas-fir site class may range from V along ridge lines to III along steep drainages. Due to the small scale used for this mapping, separation of the variabilities within this miscellaneous

land type is impractical. Severe management restrictions exist on these steep dissected landforms.

9 - Steep Dissected Landforms, from Andesites, Basalts, and Breccias

Steep dissected landforms developing on andesites, basalts, and breccias. Soil materials consist of residuum and colluvium and are usually shallow and very stony. Rock outcrop, cliffs, and talus are often associated with this unit. The soils are usually coarse-textured and excessively drained. Stream channels are usually scoured to bedrock. Site class IV and V Douglas-fir, hemlock, and true fir at higher elevations, are found on this mapping unit. Severe management restrictions exist on these steep dissected landforms.

MAPPING UNIT 12

Mapping Unit 12 consists dominantly of Landtype 12 and minor amounts of Landtype 16 and 66.

Landtype 12 is a moderately deep, slightly plastic soil derived from residual and colluvial materials. Surface soils are thin shotty loams. Subsoils are moderately thick silt loams and cobbly silty clay loams.

Bedrock materials are variable and consist of competent, moderately hard to soft volcanic materials including andesites and basalts. Compacted glacial till may also locally be present. Depth to bedrock is greater than 3 feet and usually is 6 to 8 feet.

Typically, Landtype 12 occurs on even, smooth benches with slopes less than 25 percent.

This landtype ranges in elevation from 1600 to 2500 feet and supports Site Class Low III and IV Douglas-fir with occasional Big leaf maple. The Landtype is well drained. Permeability is rapid in the surface soil and rapid to moderate in the subsoil.

Range of Profile Characteristics of Landtype 12

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Dark brown to brown shotty loams and silt loams; weak, fine, granular and subangular blocky structure; 20 to 35 percent rounded shot and 20 percent gravel by volume; slightly sticky, nonplastic; pH 5.5; 7 to 8 inches thick.
Subsoil Layers:	Brown to dark brown silt loams ranging to cobbly silty clay loams; moderate to strong, medium and fine subangular blocky structure becoming massive at depth; 15 to 40 percent subangular to rounded gravels and cobbles by volume; slightly sticky to sticky, slightly plastic; pH ranges from 5.0 to 6.5; 48 to 60 inches thick.

MAPPING UNIT 13

Mapping Unit 13 consists dominantly of Landtype 13 and minor amounts of Landtypes 16, 23, 33, 44, and 55.

Landtype 13 is a deep to very deep, slightly plastic soil derived from glacial and colluvial materials. Surface soils are thin gravelly loams. Subsoils are thick gravelly loams, silt loams, and silty clay loams.

Bedrock is variable but consists primarily of moderately competent breccias and tuffaceous materials with minor amounts of andesites and basalts. Weak to moderately compacted till occurs intermittently throughout the mapping unit. Depth to bedrock is usually greater than 10 feet.

Typically, Landtype 13 occurs on uneven to hummocky benches, basins, terraces and valley bottoms with slopes ranging to 40 percent. Small, local, steeper pitches may be present. Small local ponds are commonly present.

This landtype ranges in elevation from 2500 to 4000 feet and supports Site Class IV and Low III Douglas-fir and hemlock with occasional Western red cedar and Pacific silver-fir at higher elevations.

The landtype is generally well drained but has temporary local small ponds due to deep-seated failures. Permeability is rapid in the surface soils and moderate to locally slow in the subsoils.

Range of Profile Characteristics of Landtype 13

Litter:	Needles, leaves, twigs and decomposing organic matter. ½ to 2 inches thick.
Surface Layers:	Dark brown to dark yellowish brown gravelly loams; weak, fine, granular structure; 20 to 50 percent small subangular to rounded gravel by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 5.0 to 6.5; 9 to 15 inches thick.
Subsoil Layers:	Dark yellowish brown to dark brown gravelly loams, silt loams, and silty clay loams; weak to moderate, fine to medium subangular blocky structure becoming massive at depth; 30 to 40 percent rounded to subangular gravels and cobbles by volume; slightly sticky, slightly plastic to nonplastic; pH ranges from 5.5 to 7.0; 63 to 120 inches thick.

MAPPING UNIT 14

Mapping Unit 14 consists dominantly of Landtype 14 and minor amounts of Landtypes 23, 25 and 33.

Landtype 14 is a deep to very deep, slightly plastic to plastic Landtype derived from residual and colluvial materials. Surface soils are thin shotty loams and silt loams. Subsoils are thick silt loams, silty clay loams, and clay loams.

Bedrock materials are variable and consist of competent, weathered andesites, basalts, breccias and tuffs. Depth to bedrock is usually greater than 12 feet but locally may be near 6 feet.

Typically, Landtype 14 occurs on elevated flats, benches, and terraces that are smooth to somewhat uneven with slopes ranging from 5 to 35 percent.

This landtype ranges in elevation from 1000 to 3300 feet and supports Site Class II and High III Douglas-fir, Western red cedar and occasional Western hemlock.

The landtype is well drained. Permeability is rapid in the surface soils and moderate to slow in the subsoils.

Range of Profile Characteristics of Landtype 14

Litter:	Needles, leaves, twigs, and decomposing organic matter. 2 to 3 inches thick.
Surface Layers:	Very dark grayish brown to dark brown shotty loams and silt loams; weak to moderate, fine and medium granular and subangular structure; less than 15 percent rounded to subangular gravels and cobbles by volume; nonsticky to slightly sticky, nonplastic to slightly plastic; pH ranges from 6.0 to 7.0; 9 to 14 inches thick.
Subsoil Layers:	Dark brown, dark yellowish brown, and dark grayish brown, silt loams, silty clay loams, and clay loams; moderate to strong, fine and medium, subangular blocky structure becoming massive near bedrock; trace of rounded to subangular gravels and cobbles; slightly sticky to sticky, slightly plastic to plastic; pH ranges from 5.5 to 6.5; 62 to 88+ inches thick.

MAPPING UNIT 15

Mapping Unit 15 consists dominantly of Landtype 15 and minor amounts of Landtypes 14, 16, 17, 66 and 67.

Landtype 15 is a very deep nonplastic Landtype derived from alluvium, glacial outwash, and glacial till. Surface soils are generally thin loams, sandy loams, and loamy sands. Subsoils are usually very thick, gravelly to very gravelly cobbly sandy loams.

Bedrock materials consist of various kinds found in the survey area. Depth to bedrock is usually greater than 12 feet but locally may be as little as 6 feet.

Typically, Landtype 15 occurs along streams in valley bottoms with slopes less than 20 percent. Locally, this landtype is subject to flooding.

This landtype ranges in elevation from approximately 900 to 3600 feet and supports Site Class III Douglas-fir which tends toward Site Class II at lower elevations and Site Class IV at higher elevations.

The landtype is well to excessively drained. Permeability is rapid to very rapid in the surface soils and moderate to very rapid in the subsoils.

Range of Profile Characteristics of Landtype 15

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Very dark grayish brown loams and gravelly sandy loams; single grain to weak, fine and very fine granular and subangular blocky structure; 15 to 40 percent rounded to subangular gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 3 to 17 inches thick.
Subsoil Layers:	Dark brown to brown gravelly cobbly sandy loams; massive; weakly compacted; 35 to 70 percent rounded to subangular gravels and cobbles, trace to 10 percent stones by volume; nonsticky, nonplastic; pH 6.0 to 6.5; 100 to 120 inches plus in thickness.

MAPPING UNIT 16

Mapping Unit 16 consists dominantly of Landtype 16 and minor amounts of Landtypes 13, 15, 17 and 66.

Landtype 16 is a deep to very deep, nonplastic to slightly plastic landtype derived from colluvium, glacial till, and alluvium. Surface soils are usually thin gravelly loams and sandy loams. Subsoils are usually thick gravelly cobbly loams that locally may range to sandy loams or silt loams.

Bedrock materials are variable and consist of competent to moderately competent andesites, basalts, tuffs, and breccias. Depth to bedrock varies from 6 to greater than 12 feet.

Typically, Landtype 16 occurs on moderate to steep midslopes, toeslopes, and valley bottoms that are smooth to somewhat dissected. Slopes range from 20 to 70 percent.

This landtype ranges in elevation from 1500 to 4500 feet and supports Site Class III and IV Douglas-fir.

The landtype is well drained. Permeability is rapid in the surface soils and rapid to moderate in the subsoils.

Range of Profile Characteristics of Landtype 16

Litter:	Needles, leaves, twigs, and decomposing organic matter. 2 to 3 inches thick.
Surface Layers:	Very dark grayish brown to dark brown, shotty loams and gravelly loams; weak, fine, granular and subangular blocky structure; 30 to 60 percent, rounded and subangular gravels, cobbles, and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 6.5; 27 to 44 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown, gravelly cobbly loams ranging to gravelly sandy loams and gravelly stony loams; massive; 40 to 75 percent rounded to angular gravels, cobbles, and stones by volume; weak to moderate compaction; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 6.5; 69 to 76+ inches thick.

MAPPING UNIT 17

Mapping Unit 17 consists dominantly of Landtype 17 and minor amounts of Landtypes 15, 16, 44 and 64.

Landtype 17 is a deep to very deep, nonplastic land type derived from alluvium, glacial outwash, and glacial till. Surface soils are generally thin sandy loams. Subsoils are usually thick very gravelly cobbly sandy loams.

Bedrock materials consist of various kinds found in the survey area. Depth to bedrock is greater than 12 feet but locally may be as little as 6 feet.

Typically, Landtype 17 occurs along streams in valley bottoms with slopes less than 20 percent. Locally this landtype is subject to flooding.

This landtype ranges in elevation from 3500 feet to the upper limits of the Principal Forest Zone and supports Site Class IV and V Douglas-fir, Western hemlock, Pacific silver fir, and Western red cedar.

The landtype is well to excessively drained. Permeability is rapid to very rapid in the surface soils and moderate to very rapid in the subsoils.

Range of Profile Characteristics of Landtype 17

Same as for Landtype 15

MAPPING UNIT 19

Mapping Unit 19 consists dominantly of Landtype 19 and minor amounts of Landtypes 13, 55 and 67.

Landtype 19 is a deep, nonplastic landtype derived from glacial till and volcanic breccias. Surface soils are thin gravelly loams. Subsoils are thick gravelly cobbly loams.

Bedrock is composed of moderately competent volcanic breccias that may locally be highly weathered and soft. Depth to bedrock is usually greater than 10 feet.

Typically, Landtype 19 occurs on uneven to hummocky glacial benches and basins with slopes ranging to 45 percent.

This landtype ranges in elevation from 4000 to 4700 feet and supports Site Class II Pacific silver fir, Site Class IV Douglas-fir and Western hemlock.

The landtype is generally well drained, but may be locally poorly drained causing local ponding. Permeability is rapid to very rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 19

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Dark brown to dark yellowish brown, gravelly cobbly loams; weak, fine and medium, granular and subangular blocky structure; 35 to 65 percent subangular and rounded gravels, cobbles, stones by volume; slightly sticky, nonplastic; pH 6.5; 55 inches thick.
Subsoil Layers:	Dark yellowish brown gravelly cobbly loams and gravelly sandy loams; massive; 60 to 65 percent subangular gravels, cobbles, stones by volume; slightly sticky, nonplastic; weak to moderate compaction; pH 6.0; 33 to 60 inches thick.

MAPPING UNIT 21

Mapping Unit 21 consists dominantly of Landtype 21 and minor amounts of Landtypes 23, 31 and 61.

Landtype 21 is a shallow nonplastic to slightly plastic landtype derived from residuum and colluvium. Surface soils are thin gravelly loams. Subsoils are thin gravelly loams and clay loams.

Bedrock is moderately hard, competent to moderately competent, reddish volcanic breccias and tuffs. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 21 occurs on steep, smooth to moderately dissected upper sideslopes and ridges with slopes ranging from 60 to 90+ percent slopes.

This landtype ranges in elevation from near 3,000 to 5,000 feet and supports Site Class IV and locally V Douglas-fir along with Western hemlock and occasional true fir at higher elevations.

The soil is well to excessively drained. Permeability is very rapid in the surface soils and rapid to very rapid in the subsoils.

Range of Profile Characteristics of Landtype 21

Litter:	Needles, leaves, twigs, and decomposing organic matter. ½ to 1 inch thick.
Surface Layers:	Dark brown gravelly loams, shotty loams and loams; weak fine granular and subangular blocky structure; 25 to 60 percent rounded and subangular gravel and cobbles by volume; slightly sticky and nonplastic; pH ranges from 6.0 to 6.5; 6 to 14 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown loams to clay loams; moderate fine and medium subangular blocky structure to massive; 30 to 55 percent subangular gravels and cobbles by volume; slightly sticky and slightly plastic; pH 6.0; 23 to 32 inches thick.

MAPPING UNIT 22

Mapping Unit 22 consists dominantly of Landtype 22 and minor amounts of Landtypes 14, 23 and 33.

Landtype 22 is a moderately deep, plastic landtype derived from residuum. Surface soils are generally thin shotty silt loams. Subsoils are generally thin to moderately thick silty clay loams and clays.

Bedrock is composed of incompetent, soft, reddish breccias and tuffs. Depth to bedrock ranges from 3 to 6 feet.

Typically, landtype 22 occurs on gentle, smooth flats with slopes less than 20 percent.

This landtype ranges in elevation from 2000 to 2400 feet and supports Site Class III and II Douglas-fir, Western red cedar and Western hemlock.

The landtype is moderately well to somewhat poorly drained. Permeability is rapid in the surface soils and moderate to slow in the subsoils.

Range of Profile Characteristics of Landtype 22

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Very dark grayish brown shotty silt loams; weak, fine, subangular blocky structure; 30 percent shot and trace subangular gravel by volume; slightly sticky, non-plastic; pH 6.5; 6 to 8 inches thick.
Subsoil Layers:	Brown to reddish brown silty clay loams and clays; moderate to strong, fine and medium, subangular blocky structure becoming massive at depth; 0 to 15 percent subangular to rounded stones by volume; sticky, plastic; pH 6.0; 30 to 64 inches thick.

MAPPING UNIT 23

Mapping Unit 23 consists dominantly of Landtype 23 and minor amounts of Landtypes 14, 16, 21, 25 and 33.

Landtype 23 is a moderately deep to deep, slightly plastic to plastic landtype derived from colluvium and residuum. Surface soils are generally thin shotty loams. Subsoils are generally clay loams, silty clay loams, and clays.

Bedrock is composed of moderately competent, soft to moderately hard, reddish breccias and tuffs. Depth to bedrock ranges from 3 to 8 feet.

Typically, Landtype 23 occurs on moderate, smooth to somewhat hummocky, lower sideslopes and benches with slopes ranging from 20 to 60 percent.

This landtype ranges in elevation from 1000 to 3500 feet and supports Site Class II & III Douglas-fir, Western red cedar, and occasional Western hemlock.

The Landtype is well to moderately well drained. Permeability is rapid in the surface soils and moderate to slow in the subsoils.

Range of Profile Characteristics of Landtype 23

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Dark brown to very dark grayish brown shotty loams; moderate, fine and medium, granular structure; 15 to 40 percent shot by volume; slightly sticky, nonplastic; pH ranges from 6.0 to 7.0; 1 to 14 inches thick.
Subsoil Layers:	Reddish brown to dark brown silty clay loams, clay loams and clays; moderate to strong, medium, subangular blocky structure becoming massive at depth; 10 to 35 percent angular and subangular gravels and cobbles by volume; pH ranges from 6.5 to 4.5; 47 to 61 inches thick.

MAPPING UNIT 25

Mapping Unit 25 consists dominantly of Landtype 25 and minor amounts of Landtypes 14, 23, 33 and 35.

Landtype 25 is a deep plastic landtype derived from residuum and colluvium. Surface soils are thin loams, silty clay loams, and clay loams. Subsoils are clay loams, silty clay loams and clays.

Bedrock is incompetent, saprolitic, reddish breccias and tuffs that weather quickly to clayey materials and become plastic when remolded. Depth to bedrock varies from 6 to greater than 12 feet.

Typically, Landtype 25 occurs on hummocky, uneven landforms associated with unstable areas. Slopes range from 15 to 40 percent.

This landtype ranges in elevation from 900 to 3500 feet and supports Site Class III and II Douglas-fir and Western red cedar.

The landtype is moderately well to poorly drained. Permeability is rapid to moderate in the surface soils and slow to very slow in the subsoils.

Range of Profile Characteristics of Landtype 25

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 3 inches thick.
Surface Layers:	Dark reddish brown to very dark grayish brown, loams silty clay loams and clay loams; moderate to strong, fine and medium, granular and subangular blocky structure; slightly sticky, slightly plastic; trace to 30 percent angular to subangular gravels and cobbles by volume, pH ranges from 5.5 to 6.5; 5 to 15 inches thick.
Subsoil Layers:	Reddish brown to dark yellowish brown, clay loams, silty clay loams, and clays; moderate to strong, fine and medium, subangular blocky structure becoming massive at depth; trace to 55 percent angular gravels, cobbles and stones by volume; slightly sticky to sticky, plastic; pH ranges from 4.8 to 6.5; 67 to 120+ inches thick.

MAPPING UNIT 31

Mapping Unit 31 consists dominantly of Landtype 31 and minor amounts of Landtypes 21, 33 and 61.

Landtype 31 is a shallow, nonplastic to slightly plastic landtype derived from residuum and colluvium. Surface soils are gravelly to very gravelly loams. Subsoils are thin gravelly to gravelly cobbly loams and clay loams.

Bedrock is composed of competent to moderately competent, hard to moderately hard, green and greenish tinted tuffs and breccias. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 31 occurs on steep, smooth to moderately dissected sideslopes and ridges with slopes ranging from 60 to greater than 90 percent.

This landtype ranges in elevation from 2500 to 4500 feet and supports Site Class IV and locally Site Class V Douglas-fir. Pacific silver fir is commonly present at higher elevations and madrone is present on drier sites at lower elevations. Western hemlock is common at all elevations.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and rapid to very rapid in the subsoils.

Range of Profile Characteristics of Landtype 31

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 inch thick.
Surface Layers:	Very dark grayish brown to dark grayish brown gravelly loams that may range from sandy loams to silt loams; weak, fine and very fine, granular and subangular blocky structure; trace to 70 percent angular and subangular gravels and cobbles by volume; nonsticky to slightly sticky, nonplastic to slightly plastic; pH ranges from 6.0 to 6.5; 3 to 19 inches thick.
Subsoil Layers:	Dark brown to light olive brown gravelly and gravelly cobbly loams and clay loams; moderate, very fine to medium, subangular blocky structure; 40 to 70 percent angular and subangular gravel and cobbles by volume; nonsticky to slightly sticky, nonplastic to slightly plastic; pH ranges from 5.5 to 6.5; 17 to 33 inches thick.

MAPPING UNIT 33

Mapping Unit 33 consists dominantly of Landtype 33 and minor amounts of Landtypes 14, 16, 23, 31 and 35.

Landtype 33 is a moderately deep to locally deep, slightly plastic to plastic landtype derived from colluvium and residuum. Surface soils are thin loams and silt loams. Subsoils are clay loams and gravelly clay loams.

Bedrock is composed of moderately competent to incompetent, soft to moderately hard, green and greenish tinted breccias and tuffs. Depth to bedrock ranges from 3 to 8 feet.

Typically, Landtype 33 occurs on moderate, uneven to hummocky lower sideslopes, and benches with slopes ranging from 20 to 60 percent.

This landtype ranges in elevation from 1000 to 3500 feet and supports Site Class III Douglas-fir, Western red cedar, and Western hemlock. Ponderosa pine is occasionally found on this landtype in the vicinity of Hills Creek Reservoir.

The Landtype is moderately well drained. Permeability is rapid to moderate in the surface soils and moderate to slow in the subsoils.

Range of Profile Characteristics of Landtype 33

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Very dark grayish brown to dark brown loams and silt loams; weak to moderate fine granular structure, trace to 35 percent angular and subangular gravel by volume; slightly sticky, slightly plastic; pH ranges from 5.5 to 6.5; 5 to 19 inches thick.
Subsoil Layers:	Dark brown to olive brown clay loams and gravelly or cobbly clay loams and clays; moderate to strong, fine and medium, subangular blocky structure becoming massive at depth; 10 to 50 percent soft to hard, angular and subangular gravels and cobbles by volume; slightly sticky to sticky, slightly plastic to plastic; clay films; pH ranges from 5.3 to 6.5; 35 to 55 inches thick.

MAPPING UNIT 35

Mapping Unit 35 consists dominantly of Landtype 35 and minor amounts of Landtypes 16, 23, and 33.

Landtype 35 is a deep to very deep, plastic landtype derived from colluvium and residuum. Surface soils are thin clay loams. Subsoils are thick to very thick clays and clay loams.

Bedrock is composed of incompetent, saprolitic, green and greenish tinted breccias and tuffs. Depth to bedrock is greater than 6 feet and commonly is not observed in road cutbanks. Rock fragments in soil profile are commonly soft and easily broken by hand.

Typically, Landtype 35 occurs on gentle to moderate, hummocky, unstable areas such as slump basins and landflows with slopes ranging from 5 to 40 percent.

This landtype ranges in elevation from 1000 to 3500 feet and supports Site Class III and II Douglas-fir, Western red cedar, Western hemlock and occasional Ponderosa pine in the vicinity of Hills Creek Reservoir.

The Landtype is somewhat poorly to poorly drained. Permeability is moderate to slow in the surface soils and slow to very slow in the subsoils.

Range of Profile Characteristics of Landtype 35

Litter:	Needles, leaves, twigs and decomposing organic matter. 2 inches thick.
Surface Layers:	Very dark grayish brown to dark brown clay loams; moderate to strong, very fine and fine, subangular blocky structure; trace to 20% subangular gravel by volume; slightly sticky to sticky, slightly plastic to plastic; pH ranges from 5.3 to 6.0; 11 to 14 inches thick.
Subsoil Layers:	Dark brown to reddish brown clays and clay loams; moderate to strong, medium and fine, subangular blocky structure becoming massive at depth; trace to 45 percent subangular gravels and cobbles by volume; slightly sticky to sticky, plastic to very plastic; mottled, dark reddish brown, reddish yellow and brown; pH ranges from 5.2 to 6.5; 66 to 120(+) inches thick.

MAPPING UNIT 44

Mapping Unit 44 consists dominantly of Landtype 44 and minor amounts of Landtypes 21, 23, 61 and 64.

Landtype 44 is a moderately deep, nonplastic landtype derived from glacial till and colluvium. Surface soils are thin gravelly or shotty loams. Subsoils are thin to moderately thick gravelly or cobbly loams and sandy loams.

Bedrock is composed of competent, hard to moderately hard, volcanic breccias. Depth to bedrock ranges from 3 to 6 feet.

Typically, Landtype 44 occurs on steep, smooth sideslopes of glacial origin with slopes ranging from 40 to 80 percent.

This landtype ranges in elevation from 3500 to 5000 feet and supports Site Class IV Douglas-fir with Western hemlock and occasional Pacific silver fir at higher elevations.

The landtype is well drained. Permeability is moderate to very rapid in the surface soils and moderate to rapid in the subsoils.

Range of Profile Characteristics of Landtype 44

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Dark grayish brown to very dark grayish brown gravelly loams, shotty loams and loams; weak to moderate, fine and medium, granular structure; 20 to 50 percent rounded and subangular shot, gravels, cobbles and stone by volume; slightly sticky, nonplastic; pH 6.0; 3 to 10 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown gravelly sandy loams, cobbly loams and loams; weak to moderate, fine and medium subangular blocky structure becoming massive at depth; 25 to 55 percent subangular and angular gravels, cobbles, and stone by volume; slightly sticky, nonplastic; pH 6.0; 33 to 51 inches thick.

MAPPING UNIT 54

Mapping Unit 54 consists dominantly of Landtype 54 and minor amounts of Landtypes 44, 57 and 64.

Landtype 54 is a moderately deep, nonplastic to slightly plastic landtype derived from volcanic ejecta (pumice), colluvium, and glacial materials. Surface soils are thin deposits of pumice. Subsoils are thin gravelly silt loams.

Bedrock is composed of competent, hard and moderately hard, volcanic breccias, andesites and basalts. Depth to bedrock is 3 to 6 feet.

Typically, Landtype 54 occurs on moderate, smooth to somewhat uneven sideslopes ranging from 35 to 65 percent slope.

This landtype ranges in elevation from 4000 to 5500 feet and supports Site Class IV Douglas-fir with Western hemlock, Noble fir and occasional Mountain hemlock.

The Landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 54

Litter:	Needles, leaves, twigs, and decomposing organic matter.
Surface Layers:	Strong brown, 2 inch minus pumice; single grain; non-sticky, nonplastic; pH 7.0; 20 to 33 inches thick.
Subsoil Layers:	Dark brown gravelly silt loams; moderate, fine and medium, subangular blocky structure; 40 to 65 percent subangular to rounded gravels and cobbles by volume; pH 6.5; 21 to 35 inches thick.

MAPPING UNIT 55

Mapping Unit 55 consists dominantly of Landtype 55 and minor amounts of Landtypes 19, 21, 31 and 44.

Landtype 55 is a shallow to moderately deep, slightly plastic to plastic landtype derived from residuum and colluvium. Surface soils consist of gravelly loams and loams. Subsoils consist of gravelly silt loams, silty clay loams, and clay loams.

Bedrock is composed of moderately competent, soft to moderately hard, volcanic breccias and tuffs. Depth to bedrock ranges from less than 3 feet to greater than 8 feet.

Typically, Landtype 55 occurs on broad uneven to somewhat hummocky ridge tops and benches with slopes ranging up to 40 percent.

This landtype ranges in elevation from 3500 to 4500 feet and supports Site Class IV Douglas-fir and Site Class III Noble fir with Western hemlock and Pacific silver fir also present.

The Landtype is moderately well drained but may be locally poorly drained causing ponding. Permeability is rapid in the surface soils and moderate to slow in the subsoils.

Range of Profile Characteristics of Landtype 55

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 1¼ inches thick.
Surface Layers:	Very dark grayish brown to dark yellowish brown gravelly loams, weak to moderate, fine and medium, granular and subangular blocky structure; trace to 50 percent angular gravels and cobbles by volume; slightly sticky, slightly plastic; pH ranges from 5.5 to 6.0; 7 to 36 inches thick.
Subsoil Layers:	Yellowish brown to olive brown, gravelly silt loams, gravelly clay loams, and silty clay loams; massive; trace to 50 percent angular to subangular gravels and cobbles by volume; slightly sticky to sticky, slightly plastic to plastic; pH ranges from 4.5 to 5.7; 26 to 40 inches thick.

MAPPING UNIT 56

Mapping Unit 56 consists dominantly of Landtype 56 and minor amounts of Landtypes 54 and 57.

Landtype 56 is a deep, nonplastic landtype derived from volcanic ejecta and glacial till. Surface soils are thin deposits of pumice. Subsoils are thick gravelly cobbly loams and sandy loams.

Bedrock is composed of competent, hard, moderately fractured andesites. Depth to bedrock is greater than 10 feet.

Typically, Landtype 56 occurs on glacial valley bottoms with slopes less than 30 percent.

This landtype ranges in elevation from 4000 to 5000 feet and supports Site Class IV and Low III Douglas-fir and Site Class Low II Noble fir along with Pacific silver fir and Western hemlock.

The Landtype is well drained. Permeability is very rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 56

Litter:	Needles, leaves, twigs and decomposing organic matter. 2 inches thick.
Surface Layers:	Strong brown to yellowish brown pumice and ash, ¼ inch (-); single grain; nonsticky, nonplastic; pH 6.5; 12 to 20 inches thick.
Subsoil Layers:	Dark brown to brown, gravelly cobbly loams and sandy loams; moderate, fine and medium, subangular blocky structure becoming massive with depth, moderately compacted below 38 inches; 25 to 70 percent rounded to subangular gravel cobbles and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges 6.0 to 7.0; 100 to 120 inches (+) thick.

MAPPING UNIT 57

Mapping Unit 57 consists dominantly of Landtype 57 and minor amounts of Landtypes 54 and 56.

Landtype 57 is a deep to very deep, nonplastic landtype derived from volcanic ejecta and glacial till. Surface soils and thin deposits of pumice and ash. Subsoils are thick to very thick, nonplastic, gravelly sandy loams and gravelly cobbly sandy loams.

Bedrock is composed of competent, hard, moderately fractured andesites. Depth to bedrock varies from 10 to greater than 12 feet.

Typically, Landtype 57 occurs on moderate, smooth and somewhat uneven sideslopes of glacial origin with slopes ranging from 30 to 60 percent.

This landtype ranges in elevation from 4000 to 5500 feet and supports Site Class IV and V Douglas-fir with Pacific silver fir, Western hemlock and Noble fir present.

The landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid to moderate in the subsoils.

Range of Profile Characteristics of Landtype 57

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 1½ inches thick.
Surface Layers:	Strong brown to yellowish brown pumice and ash; single grained; nonsticky, nonplastic; pH ranges from 6.5 to 7.0; 20 to 22 inches thick.
Subsoil Layers:	Dark yellowish brown to very dark grayish brown gravelly and gravelly cobbly sandy loams; weak, fine, subangular blocky structure becoming massive with weak to moderate compaction below 3 feet; 40 to 80 percent rounded to subangular gravels, cobbles and stones by volume; nonsticky, nonplastic; pH 6.5; 78 to 120 inches thick.

MAPPING UNIT 61

Mapping Unit 61 consists dominantly of Landtype 61 and minor amounts of Landtypes 21, 31, 44 and 64.

Landtype 61 is a shallow, nonplastic landtype derived from residuum and colluvium. Surface soils are thin gravelly to very gravelly loams. Subsoils are thin gravelly or cobbly loams.

Bedrock is composed of competent, hard, highly to moderately fractured andesites and basalts. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 61 occurs on steep, smooth to moderately dissected sideslopes and ridges with slopes ranging from about 60 to greater than 90 percent.

This landtype ranges in elevation from 1000 to 5000 feet and supports Site Class IV and V Douglas-fir and hemlock. Pacific silver fir and Western white pine occur at higher elevations.

The Landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 61

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 inch thick.
Surface Layers:	Dark brown gravelly to very gravelly loams; weak, fine, granular structure; 30 to 60 percent rounded, angular and subangular gravels by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 7.0; 6 to 7 inches thick.
Subsoil Layers:	Dark yellowish brown to dark brown, gravelly or cobbly loams ranging to sandy loams and silt loams; massive; 50 to 75 percent angular to subangular gravels, cobbles and stones by volume; nonsticky to slightly sticky, nonplastic; pH 6.0; 11 to 15 inches thick.

MAPPING UNIT 62

Mapping Unit 62 consists dominantly of Landtype 62 and minor amounts of Landtype 4.

Landtype 62 is a shallow to moderately deep, nonplastic landtype derived from recent lava flows. Soils consist of cindery, gravelly loamy sands and sands that locally may range to loams.

Bedrock is composed of competent, recent lava flows from the high Cascades. Depth to bedrock ranges from the surface to 6 feet.

Typically, Landtype 62 occurs on recent lava flows. Overall landscape slope is less than 35 percent, but the actual surface may be very irregular due to collapsed lava tubes, and pressure ridges.

This landtype ranges in elevation from 3300 to 4000 feet and supports Site Class IV and V Douglas-fir.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and subsoils.

Range of Profile Characteristics of Landtype 62

Litter:	Needles, leaves, twigs and decomposing organic matter. ½ inch thick.
Surface Layers:	Very dark grayish brown to dark brown cobbly gravelly loamy sands; massive; 50 to 90 percent subangular, angular and rounded gravels, cobbles, and stones by volume; nonsticky, nonplastic; pH ranges from 6.0 to 7.5; 30 to 48 inches thick.

MAPPING UNIT 63

Mapping Unit 63 consists dominantly of Landtype 63 and minor amounts of Landtypes 13, 64 and 66.

Landtype 63 is a moderately deep, nonplastic landtype derived from residual materials. Surface soils are thin loams. Subsoils are thin to moderately thick loams and silt loams.

Bedrock is composed of competent, hard, highly to moderately fractured andesites and basalts. Depth to bedrock ranges from 3 to 6 feet.

Typically, Landtype 63 occurs on gentle, smooth, high elevation lava flows with slopes less than 35 percent.

This landtype ranges in elevation from 3200 to 4400 feet and supports Site Class Low III and High IV Douglas-fir.

The Landtype is well drained. Permeability is rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 63

Litter:	Needles, leaves, twigs, and decomposing organic matter. ½ to 1½ inches thick.
Surface Layers:	Very dark grayish brown to dark brown loams; weak, fine, granular structure; 10 to 30 percent angular to rounded gravels, cobbles and stones by volume; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 13 to 19 inches thick.
Subsoil Layers:	Brown loams and silt loams; weak, fine and medium subangular blocky structure becoming massive at depth; 10 to 35 percent angular to rounded gravels and cobbles by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 7.0; 19 to 35 inches thick.

MAPPING UNIT 64

Mapping Unit 64 consists dominantly of Landtype 64 and minor amounts of Landtypes 21, 44 and 61.

Landtype 64 is a moderately deep, nonplastic landtype derived from glacial till and colluvium. Surface soils are thin gravelly sandy loams and loams. Subsoils are thin to moderately thick, gravelly or cobbly sandy loams and loams.

Bedrock is composed of competent, hard, highly fractured andesites and basalts. Depth to bedrock ranges from 3 to 6 feet.

Typically, Landtype 64 occurs on moderate to steep, smooth sideslopes that have been glacially modified with slopes ranging from 40 to 80 percent.

This landtype ranges in elevation from 3500 to 5000 feet and supports Site Class IV Douglas-fir with Pacific silver fir, Western white pine, Western red cedar and Western hemlock.

The Landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 64

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 3 inches thick.
Surface Layers:	Dark brown gravelly sandy loams and fine sandy loams; massive to weak, fine and medium granular structure; 10 to 45 percent subangular to rounded gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 13 to 23 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown gravelly or cobbly sandy loams and loams; massive to weak, fine and medium subangular blocky structure; 45 to 60 percent rounded to subangular gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 5.8 to 7.0; 15 to 35 inches thick.

MAPPING UNIT 66

Mapping Unit 66 consists dominantly of Landtype 66 and minor amounts of Landtypes 13, 16, 19 and 67.

Landtype 66 is a deep to very deep, nonplastic landtype derived from volcanic ejecta and glacial till. Surface soils are thin sandy loams. Subsoils are thick gravelly or cobbly sandy loams and loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock is usually greater than 6 feet.

Typically, Landtype 66 occurs on gentle, smooth to somewhat uneven glaciated lava flows with slopes less than 40 percent.

This landtype ranges in elevation from 2800 to 4100 feet and supports Site Class Low III and IV Douglas-fir, Western hemlock, Western red cedar and occasional Pacific silver fir.

The Landtype is well drained. Permeability is rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 66

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Dark brown to dark yellowish brown sandy loams, fine sandy loams, shotty sandy loams, and loams; massive to weak, fine, granular structure; trace to 35 percent rounded to subangular gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 5.0 to 7.0; 6 to 21 inches thick.
Subsoil Layers:	Dark yellowish brown, dark brown, and reddish brown gravelly sandy loams and loams; weak to moderate, fine and medium, subangular blocky structure becoming massive with weak to strong compaction; 40 to 70 percent rounded to subangular gravels, cobbles, and stone by volume; nonsticky, nonplastic; pH ranges from 5.5 to 7.0; 61 to 136 inches thick.

MAPPING UNIT 67

Mapping Unit 67 consists dominantly of Landtype 67 and minor amounts of Landtypes 16, 19 and 66.

Landtype 67 is a moderately deep to deep, nonplastic landtype derived from glacial till and volcanic ejecta. Surface soils are thin sandy loams and loams. Subsoils are thin to moderately thick gravelly and cobbly sandy loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock ranges from 4 to 10 feet.

Typically, Landtype 67 occurs on gentle, smooth to uneven glaciated lava flows with slopes less than 40%.

This landtype ranges in elevation from 3500 to 4500 feet and supports Site Class IV and V Douglas-fir, Western hemlock, Pacific silver fir, Western red cedar, and occasional Engelmann spruce.

The Landtype is well drained but may locally be poorly drained causing ponding. Permeability is rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 67

Litter:	Needles, leaves, twigs, and decomposing organic matter. 3/4 to 1½ inches thick.
Surface Layers:	Very dark grayish brown to dark brown sandy loams and loams; weak, fine and very fine granular structure; 20 to 30 percent rounded to subangular gravels and cobbles by volume; nonsticky, nonplastic; pH ranges 6.5 to 7.0; 2½ to 5 inches thick.
Subsoil Layers:	Dark brown to dark gray gravelly sandy loams, and gravelly cobbly loams; weak to moderate, fine and very fine subangular blocky structure becoming massive with moderate to strong compaction at depth; 35 to 75 percent rounded to subangular gravels, cobbles, and stones by volume; nonsticky, nonplastic; pH ranges from 6.5 to 7.0; 40 to 117 inches thick.

MAPPING UNIT 68

Mapping Unit 68 consists dominantly of Landtype 68 and minor amounts of Landtypes 81 and 82.

Landtype 68 is a moderately deep, nonplastic landtype derived from black volcanic sands and cinders. Surface soils are thin sands and loamy sands. Subsoils are moderately thick sands and cinders.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock is usually 3 to 6 feet.

Typically, Landtype 68 occurs on moderate, smooth sideslopes with slopes ranging from 30 to 60 percent.

This landtype ranges in elevation from 3700 to 4300 feet and supports Site Class IV and V Douglas-fir with Pacific silver fir, Grand fir, and Western white pine.

The landtype is excessively drained. Permeability is very rapid in the surface soils and very rapid in the subsoils.

Range of Profile Characteristics of Landtype 68

Litter:	Needles, leaves, twigs, and decomposing organic matter. 2 inches thick.
Surface Layers:	Very dark grayish brown sands and angular cinders; single grain; nonsticky, nonplastic, pH 6.0 to 6.5; 14 inches thick.
Subsoil Layers:	Dark brown to black cinders; single grain; nonsticky, nonplastic; pH 6.5; 40+ inches thick.

MAPPING UNIT 69

Mapping Unit 69 consists dominantly of Landtype 69 and minor amounts of Landtypes 82 and 85.

Landtype 69 is a deep to very deep landtype derived from black volcanic sands overlying glacial till. Surface soils are thin sands. Subsoils are thin to thick sands over glacial till.

Bedrock is composed of competent, hard andesite, and basalts. Depth to bedrock is greater than 8 feet.

Typically, Landtype 69 occurs on gentle, high elevation flats near recent volcanic cinder cones, with slopes less than 30 percent.

This landtype ranges in elevation from 3700 to 4300 feet and supports Site Class IV and V Douglas-fir.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and very rapid in the subsoils.

Range of Profile Characteristics of Landtype 69

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1 inch thick.
Surface Layers:	Black to dark brown sands; single grain; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 72 to 100+ inches thick.

MAPPING UNIT 71

Mapping Unit 71 consists dominantly of Landtype 71 and minor amounts of Landtype 74.

Landtype 71 is a shallow, nonplastic landtype derived from residual and colluvial materials. Surface soils are thin sandy loams and loams. Subsoils are thin gravelly sandy loams, fine sandy loams, and loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 71 occurs on steep, smooth to uneven upper sideslopes and ridges with slopes ranging from 45 to 90 percent.

This landtype ranges in elevation from 4400 to 6000 feet and supports true fir-Mountain hemlock type vegetation.

The Landtype is well drained. Permeability is rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 71

Litter:	Needles, leaves, twigs, and decomposing organic matter. ½ to 1 inch thick.
Surface Layers:	Very dark gray to very dark grayish brown sandy loams and loams; weak, fine, granular structure; trace to 45 percent angular gravels and cobbles by volume; non-sticky to slightly sticky, nonplastic; pH ranges from 5.0 to 6.0; 6 to 12 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown gravelly sandy loams and loams; weak, fine and medium, subangular blocky structure; 45 to 70 percent angular gravels, cobbles and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 5.5 to 7.0; 12 to 26 inches thick.

MAPPING UNIT 73

Mapping Unit 73 consists dominantly of Landtype 73 and minor amounts of Landtypes 82, 92 and 93.

Landtype 73 is a shallow to moderately deep, nonplastic landtype derived from residual, glacial, and volcanic materials. Surface soils are thin sandy loams and loams. Subsoils are thin to moderately thick loams ranging to silt loams.

Bedrock is composed of competent, hard, andesites and basalts. Depth to bedrock ranges from less than 3 feet to 6 feet.

Typically, Landtype 73 occurs on gentle, uneven high elevation flats and benches with slopes less than 30 percent. Small meadows and rock outcrops occur within this landtype.

This landtype ranges in elevation from 3800 to 5300 feet and supports True fir-Mountain hemlock vegetation including Western white pine, Lodgepole pine, and occasional Engelmann spruce.

The landtype is well drained. Permeability is rapid in the surface soils and rapid to moderate in the subsoils.

Range of Profile Characteristics of Landtype 73

Litter:	Needles, leaves, twigs, and decomposing organic matter. Sparse to ½ inch thick.
Surface Layers:	Very dark grayish brown to dark reddish brown sandy loams and loams; weak, fine and very fine, granular structure; 5 to 25 percent subangular to rounded gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 5.5 to 7.0; 6 to 9 inches thick.
Subsoil Layers:	Dark reddish brown to dark brown loams ranging to silt loams; moderate, fine and medium, subangular blocky structure becoming massive at depth; 15 to 35 percent subangular and rounded gravels and cobbles by volume; slightly sticky, nonplastic; pH ranges from 6.0 to 6.5; 30 to 60 inches thick.

MAPPING UNIT 74

Mapping Unit 74 consists dominantly of Landtype 74 and minor amounts of Landtypes 44, 64 and 71.

Landtype 74 is a moderately deep, nonplastic landtype derived from glacial till, colluvium, and volcanic materials. Surface soils are thin sandy loams and gravelly or cobbly loams. Subsoils are gravelly or cobbly sandy loams and loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock ranges from 3 to 6 feet.

Typically, Landtype 74 occurs on moderate, smooth to uneven sideslopes of glacial origin, with slopes ranging from 35 to 55 percent slope.

This landtype ranges in elevation from 4800 to 5500 feet and supports True fir-Mountain hemlock vegetation with lesser amounts of Lodgepole pine and subalpine fir. Few scattered Douglas-fir may occur at lower elevations.

The landtype is well drained. Permeability is rapid to very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 74

Litter:	Needles, leaves, twigs, and decomposing organic matter. Sparse to 1 inch thick.
Surface Layers:	Very dark grayish brown to dark brown gravelly or cobbly loams and sandy loams; weak, fine, granular structure to massive; 10 to 45 percent angular gravels and cobbles by volume; nonsticky to slightly sticky, nonplastic; pH range, from 6.0 to 6.5; 10 to 16 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown gravelly or cobbly sandy loams and loams; moderate, fine and medium, subangular structure becoming massive at depth; 45 to 65 percent rounded, angular and subangular gravels, cobbles and stones by volume; nonsticky to slightly sticky, nonplastic to slightly plastic; pH ranges from 6.0 to 6.5; 28 to 32(+) inches thick.

MAPPING UNIT 75

Mapping Unit 75 consists dominantly of Landtype 75 and minor amounts of Landtypes 73 and 74.

Landtype 75 is a moderately deep to deep, nonplastic soil derived from glacial till and volcanic materials. Surface soils are thin gravelly fine sandy loams. Subsoils are moderately thick to thick gravelly and gravelly cobbly sandy loams and fine sandy loams.

Bedrock is composed of competent, hard andesites, basalts, and volcanic breccias. Depth to bedrock ranges from 4 to 8(+) feet.

Typically, Landtype 75 occurs on gentle, smooth to uneven glacial valley bottoms and cirque basins with slopes less than 35 percent.

This landtype ranges in elevation from 4500 to 5000(+) feet and supports True fir-Mountain hemlock vegetation. Small amounts of Douglas-fir may occur at lower elevations.

The Landtype is well drained but may be locally poorly drained causing ponding. Permeability is rapid to very rapid in the surface soils and rapid to moderate in the subsoils.

Range of Profile Characteristics of Landtype 75

Litter:	Needles, leaves, twigs, and decomposing organic matter. 1½ to 2 inches thick.
Surface Layers:	Very dark grayish brown to very dark gray gravelly fine sandy loams and fine sandy loams; weak, fine, granular structure to massive; trace to 45 percent angular to rounded gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 5.5 to 6.5; 11 to 18 inches thick.
Subsoil Layers:	Dark brown to dark grayish brown gravelly and gravelly cobbly sandy loams; weak, fine, subangular blocky structure becoming massive with weak to moderate compaction; 35 to 70 percent subangular and rounded gravels, cobbles, and stones by volume; nonsticky, nonplastic; pH ranges from 5.0 to 7.0; 37 to 78 inches thick.

MAPPING UNIT 81

Mapping Unit 81 consists dominantly of Landtype 81 and minor amounts of Landtypes 71 and 91.

Landtype 81 is a shallow, nonplastic landtype derived from black volcanic sands and cinders. Surface soils are thin loamy sands. Subsoils are thin gravelly loamy sands.

Bedrock is composed of competent hard to moderately hard volcanic materials including andesites and basalts. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 81 occurs on moderate to steep, smooth to uneven sideslopes and ridges in areas adjacent to recent volcanic activity. This landtype contains up to 30 percent surface rock. Slopes are greater than 40 percent.

This landtype ranges in elevation from 4300 to 5000 feet and supports True fir-Mountain hemlock vegetation along with Lodgepole pine. Site Class for Lodgepole pine is VI and VII where measured.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and very rapid in the subsoils.

Range of Profile Characteristics of Landtype 81

Litter:	Needles, leaves, twigs, and decomposing organic matter. Sparse to 1 inch thick.
Surface Layers:	Black loamy sands; single grain; trace of angular and subangular gravels and cobbles; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 3 to 7 inches thick.
Subsoil Layers:	Dark brown to dark yellowish brown loamy fine sands and gravelly loamy sands; massive; 20 to 60 percent angular and subangular gravels and cobbles by volume; nonsticky, nonplastic; pH ranges from 6.5 to 7.0; 22 to 31 inches thick.

MAPPING UNIT 82

Mapping Unit 82 consists dominantly of Landtype 82 and minor amounts of Landtypes 81 and 85.

Landtype 82 is a shallow to moderately deep landtype derived from black volcanic sands and residuum. Surface soils are thin to moderately thick sands. Subsoils are thin to moderately thick sands and loamy sands.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock ranges from less than 1 foot to greater than 5 feet.

Typically, Landtype 82 occurs on flat, benchy, lava flows near areas of recent volcanic activity. Up to 35 percent rock outcrop occurs within this mapping unit. Slopes are less than 30 percent except for small steep pitches on benches.

This landtype ranges in elevation from 4000 to 4500 feet and supports True fir-Mountain hemlock vegetation. Lodgepole pine is common following fires. Site Class for Lodgepole pine is VI and VII where measured.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and very rapid in the subsoils.

Range of Profile Characteristics of Landtype 82

Litter:	Needles, leaves, twigs and decomposing organic matter. Sparse.
Surface Layers:	Black sands and coarse sands; single grain; trace subangular gravels and cobbles; nonsticky, nonplastic; pH ranges from 6.0 to 7.0; 16 to 40 inches thick.
Subsoil Layers:	Dark brown to black loamy sands and sands; massive; trace of subangular gravels, cobbles, and stones; nonsticky, nonplastic, pH 6.0 to 7.0; 10 to 20 inches thick.

MAPPING UNIT 85

Mapping Unit 85 consists dominantly of Landtype 85 and minor amounts of Landtype 82.

Landtype 85 is a deep to very deep, nonplastic landtype derived from black volcanic sands and cinders. Surface soils are thin sands. Subsoils are thick sands and cinders.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock is usually greater than 8 feet.

Typically, Landtype 85 occurs on gentle, high-elevation flats near areas of recent volcanic activity. Slopes are usually less than 15 percent. In areas devoid of vegetation and favorable to high winds, sand "blow-outs" occur.

This landtype ranges in elevation from 3700 to 4500 feet and supports True fir-Mountain hemlock vegetation. Lodgepole pine is common following fires. Lodgepole pine Site Class is VI & VII where measured.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and very rapid in the subsoils.

Range of Profile Characteristics of Landtype 85

Litter:	Needles, leaves, twigs and decomposing organic matter. Sparse to ½-inch thick.
Surface Layers:	Black angular sands; single grain; nonsticky, nonplastic; pH ranges from 6.0 to 6.5; 2 to 8 inches thick.
Subsoil Layers:	Very dark grayish brown to black angular sands. Angular cindery sands and cinders; single grain; nonsticky, nonplastic; pH ranges from 6.5 to 7.0; 81 to 120(+) inches thick.

MAPPING UNIT 91

Mapping Unit 91 consists dominantly of Landtype 91 and minor amounts of Landtypes 71 and 81.

Landtype 91 is a shallow, nonplastic landtype derived from volcanic ejecta, residual and colluvial materials. Surface soils are thin cobbly sandy loams. Subsoils are thin cobbly stony loams and sandy loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock is usually less than 3 feet.

Typically, Landtype 91 occurs on steep, smooth to moderately dissected sideslopes and ridges with slopes greater than 55 percent. Up to 30 or 40 percent stones and cobbles may be found on the soil surface.

This landtype ranges in elevation from 4500 to 6000 feet and supports True fir-Mountain hemlock vegetation.

The landtype is excessively drained. Permeability is rapid to very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 91

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Very dark grayish brown, gravelly or cobbly sandy loams; weak, fine, granular structure; 40 to 70 percent rounded subangular gravels, cobbles and stones by volume; nonsticky, nonplastic; pH ranges from 5.5 to 6.5; 8 to 12 inches thick.
Subsoil Layers:	Dark brown, gravelly or cobbly stony sandy loams and loams; massive; 40 to 80 percent rounded to subangular gravels, cobbles, and stones by volume; nonsticky, nonplastic; pH ranges from 6.5 to 7.0; 14 to 24 inches thick.

MAPPING UNIT 92

Mapping Unit 92 consists dominantly of Landtype 92 and minor amounts of Landtypes 91 and 93.

Landtype 92 is a shallow to moderately deep, nonplastic landtype derived from volcanic ejecta (pumice and ash) and glacial till. Surface soils are thin deposits of pumice and ash. Subsoils are thin to moderately thick gravelly or cobbly sandy loams and loams.

Bedrock is composed of competent, hard andesite and basalt. Depth to bedrock ranges from less than 3 feet to 6 feet.

Typically, Landtype 92 occurs on high elevation glacial flats and benches with slopes less than 35 percent. Up to 30-percent rock outcrop occurs within the mapping unit.

This landtype ranges in elevation from 4300 to 6000 feet and supports True fir-Mountain hemlock vegetation with some Lodgepole pine and Western white pine. Site Class for Pacific Silver Fir is III, Noble Fir IV, Mountain hemlock V and Lodgepole Pine VI, where measured.

The Landtype is excessively drained. Permeability is very rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 92

Litter:	Needles, leaves, twigs and decomposing organic matter. Sparse to 1 inch thick.
Surface Layers:	Strong brown to light yellowish brown pumice and ash; single grain; nonsticky, nonplastic; pH ranges from 6.0 to 7.0; 11 to 26 inches thick.
Subsoil Layers:	Very dark grayish brown to dark yellowish brown gravelly or cobbly sandy loams and loams; weak (locally moderate), fine and medium subangular blocky structure becoming massive, moderate to strong compaction at depth; 45 to 75 percent rounded to subangular gravels, cobbles, and stones by volume; nonsticky, nonplastic; pH ranges 6.0 to 7.0; 29 to 59 inches thick.

MAPPING UNIT 93

Mapping Unit 93 consists dominantly of Landtype 93 and minor amounts of Landtypes 92 and 95.

Landtype 93 is a moderately deep to deep, nonplastic landtype, derived from volcanic ejecta (pumice and ash), glacial till, and colluvium. Surface soils are thin deposits of pumice and ash. Subsoils are moderately thick to thick gravelly sandy loams and loams.

Bedrock is composed of competent, hard andesites and basalts. Depth to bedrock ranges from 3 feet to greater than 6 feet.

Typically, Landtype 93 occurs on high elevation glacial flats and terraces with slopes less than 40 percent.

This landtype ranges in elevation from 4000 to 5800 feet and supports True fir-Mountain hemlock vegetation. Occasional Douglas-fir may be present at lower elevations. Site Class III to V Pacific Silver Fir, where measured.

The Landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid to slow in the subsoils.

Range of Profile Characteristics of Landtype 93

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 1½ inches thick.
Surface Layers:	Dark yellowish brown, strong brown, and very dark gray, pumice and ash; single grain; nonsticky, nonplastic; pH ranges 6.0 to 7.0; 18 to 26 inches thick.
Subsoil Layers:	Very dark grayish brown to dark yellowish brown gravelly sandy loams and loams; weak, fine and medium, subangular blocky structure becoming massive with moderate to strong compaction at depth; 50 to 75 percent rounded to subangular gravels, cobbles, and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 7.5; 29 to 102 inches thick.

MAPPING UNIT 94

Mapping Unit 94 consists dominantly of Landtype 94 and minor amounts of Landtypes 91 and 95.

Landtype 94 is a moderately deep, nonplastic landtype derived from volcanic ejecta (pumice and ash), glacial till, and colluvium. Surface soils are thin to moderately deep deposits of pumice and ash. Subsoils are moderately thick gravelly sandy loams and loams.

Bedrock is composed of competent, hard andesites, basalts and volcanic breccias. Depth to bedrock ranges from 3 to 6 feet.

Typically, Landtype 94 occurs on moderate, smooth to uneven glacial slopes of 35 to 60 percent.

This landtype ranges in elevation from 4500 to 6000 feet and supports True fir-Mountain hemlock vegetation.

The landtype is well to excessively drained. Permeability is very rapid in the surface soils and rapid in the subsoils.

Range of Profile Characteristics of Landtype 94

Litter:	Needles, leaves, twigs, and decomposing organic matter. ½ to 1½ inches thick.
Surface Layers:	Yellowish brown to strong brown pumice and ash; single grain; nonsticky, nonplastic; pH ranges from 6.0 to 7.0; 20 to 41 inches thick.
Subsoil Layers:	Brown to dark brown gravelly sandy loams and loams; massive; 50 to 70 percent rounded to subangular gravels, cobbles, and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 7.0; 20 to 31 inches thick.

MAPPING UNIT 95

Mapping Unit 95 consists dominantly of Landtype 95 and minor amounts of Landtypes 93 and 94.

Landtype 95 is a deep to very deep, nonplastic landtype derived from volcanic ejecta (pumice and ash), glacial till, and alluvium. Surface soils are thin deposits of pumice and ash. Subsoils are thick to very thick gravelly sandy loams and loams.

Bedrock is composed of competent, hard andesites, basalts, and volcanic breccias. Depth to bedrock is greater than 8 feet.

Typically, Landtype 95 occurs along glacial troughs, valley bottoms, and some cirque basins with slopes less than 35 percent.

This landtype ranges in elevation from 4500 to 5500 feet and supports True fir-Mountain hemlock vegetation with occasional Douglas-fir at lower elevations. Site Class for Mountain hemlock is III, Noble fir IV and Douglas-fir V, where measured.

The landtype is well drained. Permeability is very rapid in the surface soils and rapid to moderate in the subsoils.

Range of Profile Characteristics of Landtype 95

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 2 inches thick.
Surface Layers:	Strong brown to yellowish brown pumice and ash; single grain; nonsticky, nonplastic, pH ranges from 6.0 to 7.0; 20 to 26 inches thick.
Subsoil Layers:	Dark brown to very dark grayish brown gravelly sandy loams and loams; weak, fine, subangular blocky structure becoming massive, moderately compact at depth; 40 to 65 percent, rounded and subangular gravels, cobbles, and stones by volume; nonsticky to slightly sticky, nonplastic; pH ranges from 6.0 to 6.5; 76 to 120+ inches thick.

APPENDIX I

CLIMATE

This appendix contains a brief narrative description of the climate of the Soil Resource Inventory survey area. Also included in this appendix are tables of Average Mean Monthly Temperatures and Precipitation Data, Average Monthly Snow Survey Measurements, and an Isohyetal Map of the survey area.

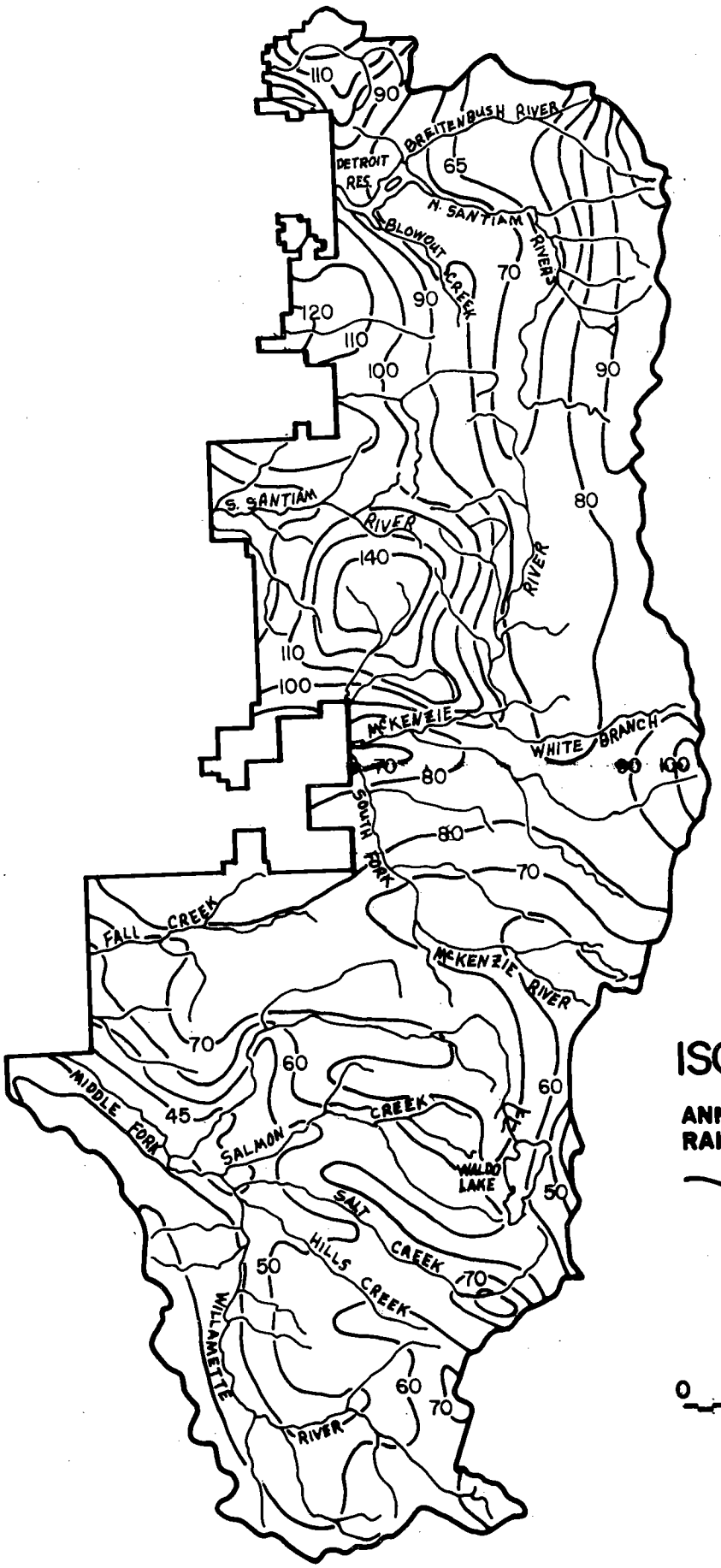

FIGURE 2

ISOHYETAL MAP

ANNUAL AVERAGE RAINFALL IN INCHES

70

0 5 10 20

CLIMATE 1/

The climate of the Willamette National Forest is influenced by the position and intensity of high and low pressure systems over the North Pacific Ocean and by variation in topography. Moist maritime air masses moving from west to east provide a great deal of moisture for the western slope of the Cascade Range. Although precipitation amounts vary greatly throughout the forest, the general pattern is similar. Precipitation is lowest in the major valley bottoms and increases as elevation increases. Conversely, temperature averages are higher in the major valley bottoms and decrease with increasing elevation. Precipitation varies from 40 inches on the western boundary valley bottoms to 140 inches on the higher ridges. Most of the precipitation falls in the 5 months, November through March. Most of the precipitation falls as rain in the valley bottoms and as snow above 4,000-feet elevation. Temperature variations range from a recorded winter low of -15°F at Santiam Pass to a recorded summer high of 112°F at Oakridge Ranger Station. The lowest recorded mean January temperature is 22.5°F (1969) at Santiam Pass. The highest recorded mean August temperature is 72.8°F (1967) at Detroit Dam.

Winter Conditions: During the fall and winter, low pressure centers form in the North Pacific Ocean. Counterclockwise air circulation around these low pressure systems result in a prevailing southwesterly air flow. This results in a wet season from mid-October through mid-April. Between 40 and 59 percent of the total precipitation falls during the 3 winter months, December through February, and 20 to 25 percent during the fall months.

1/ Gilbert L. Sterns, Climate of the States; Oregon, U.S. Weather Bureau, Washington, D.C., No. 60-35, February 1960

The forced ascent of the air masses from the west causes them to give up moisture. Since the rain-bearing potential of these marine winds has already been greatly reduced by passage over the Coast Range, the precipitation on the west slope of the Cascades is only from one-half to two-thirds as great as for the Coast Range.

Snowfall is the heaviest in the State in the higher levels of the Cascades. From the limited records available for these areas it appears that annual average total snowfall ranges from 300 to 550 inches. Snow course averages show that above 4500 feet, on-the-ground snow depths are approximately 60 to 100 inches and persist from early December to the latter part of April. On peaks above 7000 feet some snow persists in glacial form the year around.

Flooding occurs during some winters in the major valleys due to a combination of: (1) moderate to heavy snowpack on the west slope and summit of the Cascades; (2) a period of several days of moderate to heavy rain; and (3) warm southerly winds. Except for periodic flooding during some winters, annual peak stream discharge occurs between April and June, the period of most rapidly melting snow. Moderate to heavy rains falling on a heavy snowpack constitutes a major flood threat.

Summer Conditions: During mid to late spring, low pressure centers move further north and are gradually replaced by high pressure systems with their clockwise circulation of air, resulting in a prevailing northwesterly flow of air. The air becomes warmer and dryer as it moves inland resulting in a dry season beginning in late spring and reaching a peak in summer. Only 6 percent of the annual average precipitation occurs during the summer months and just 20 to 25 percent occurs during the spring months. The hottest

weather, lowest relative humidity and greatest danger of forest fires occur during periods of easterly winds.

The Western Cascades have a normal dry period each summer. Damaging drought conditions result when the dry period begins too early in the spring. A marked deficiency in moisture during spring and early summer results in poor survival of tree seedlings, grass seedings, and an extended fire season.

Occasionally, extremely low humidities will occur in the Western Cascades during summer and early fall. Humidities as low as 10 to 20 percent may be recorded during the warmest part of the day. Evaporation rates from May 1st through September 30th range from a low of 18 inches at Odell Lake on the Cascade Range to 31 inches at Fern Ridge Reservoir on the valley floor near Eugene.

Thunderstorms occur most frequently during the summer months, and each year a considerable number of forest fires are started by lightning strikes.

Figure 3

AVERAGE MONTHLY SNOW SURVEY MEASUREMENTS 1/

Willamette National Forest and Vicinity

STATION	ELEV.	PERIOD	January			February			March			April			May			June		
			(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Breitenbush T9S,R7E,S21	2325'	1941-52	3.75	1.13	8	9.50	3.29	9	11.5	3.96	10	9.17	3.39	9	7.50	1.08	4	M 2/	M	0
Cascade Summit T23S,R6E,S7	4880'	1929-67	42.50	12.31	20	61.10	20.29	37	71.8	26.81	23	77.42	31.21	38	60.14	27.66	22	14.50	6.92	10
Dead Horse Grade T16S,R7E,S13	3800'	1949-67	23.41	5.00	17	35.11	13.11	18	49.77	17.53	18	53.77	21.85	18	27.85	11.92	13	0	0	0
Detroit City T10S,R5E,S1	1610'	1949-67	3.06	.64	17	7.05	2.18	17	3.26	1.36	19	.06	.006	18	0	0	17	0	0	3
Detroit Dam T10S,R5E,S7	1580'	1949-67	2.35	.44	17	3.22	0.65	18	1.17	.54	19	0	0	18	0	0	18	0	0	3
Hogg Pass T13S,R7½E,S24	4755'	1938-67	52.35	15.56	26	77.83	26.53	30	90.54	36.13	27	97.33	43.68	30	95.71	46.08	21	46.33	23.40	3
Lookout Point Dam T19S,R1W,S13	750'	1950-67	0	0	17	0	0	17	0	0	18	0	0	18	0	0	18	0	0	8
Lost Creek Ranch T16S,R6E,S24	1956'	1951-67	3.53	1.05	15	10.31	3.43	16	7.93	2.91	14	3.63	1.35	16	0	0	13	M	M	0
Marion Forks T11S,R7E,S28	2730'	1941-67	15.44	4.92	25	28.88	9.38	26	31.27	12.25	26	28.21	12.19	26	7.61	3.56	18	0	0	3
McCredie Springs T21S,R4E,S36	2170'	1949-67	1.88	.31	17	3.28	.86	18	1.84	.51	19	0	0	18	0	0	18	0	0	8
McKenzie T15S,r7½E,S35	4800'	1939-67	53.93	17.28	16	67.31	25.26	24	101.63	39.67	19	108.21	44.54	28	89.85	44.45	13	M	M	0
McKenzie Bridge T16S,R5E,S13	1372'	1950-67	1.81	.46	16	4.37	1.33	19	2.82	.76	17	0	0	17	0	0	13	M	M	0
Mill City T9S,R3E,S29	826'	1949-67	.88	.18	16	.89	.19	18	0	0	19	0	0	18	0	0	18	0	0	3
Oakridge T21S,R3E,S16	1310'	1950-67	.76	.17	17	0	0	18	0	0	18	0	0	18	0	0	18	0	0	7
Railroad Overpass T22S,R5E,S21	2750'	1949-67	4.70	.91	17	10.50	3.13	18	10.26	3.78	19	5.00	2.01	18	.18	.06	17	0	0	8
Salt Creek Falls T22S,R5½E,S32	4000'	1949-67	20.94	5.32	18	35.22	11.76	18	42.84	15.48	19	49.56	19.38	18	26.94	11.44	18	1.44	.71	9
Santiam Junction T13S,R7E,S14	3990'	1941-67	42.75	12.72	25	51.66	18.99	27	61.57	22.32	27	38.54	17.07	27	15.50	7.50	20	0	0	3
Vida T16S,R2E,S28	800'	1950-67	.56	.16	16	.89	.22	18	0	0	16	0	0	17	0	0	13	M	M	0
Waldo Lake T21S,R6E,S15	5500	1938-67	M	M	0	48.71	18.87	21	79.57	20.61	7	80.75	31.14	28	90.50	38.90	2	50.0	23.20	1
White Branch Slide T16S,R7E,S15	2800'	1949-67	12.52	2.72	17	18.21	5.74	19	9.67	6.42	18	14.72	5.77	18	2.90	1.29	13	M	M	0
Whitewater Bridge T10S,R7E,S28	2175'	1949-67	7.41	2.16	17	17.56	5.19	18	15.44	5.75	19	8.44	3.69	18	0	0	17	0	0	3
Willamette Pass T24S,R5½E,S33	5600'	1928-67	M	M	0	80.05	27.06	18	96.25	34.83	16	104.83	42.14	24	96.26	44.19	19	M	M	0

1/ Frost, W.T. and Tom George, Summary of Snow Measurements for Oregon, Soil Conservation Service, U.S. Department of Agriculture, Portland, Oregon, 1969

2/ Missing - Measurement not taken.

(1) Average Snow Depth in Inches
(2) Average Water Content in Inches
(3) Number of Months Measurements Taken

FIGURE 4

CLIMATIC DATA [1/]
WILLAMETTE NATIONAL FOREST AND ADJACENT AREAS
AVERAGE MEAN MONTHLY AND ANNUAL TEMPERATURE AND PRECIPITATION

STATION	ELEVATION	PERIOD	JANUARY (1)	JANUARY (2)	FEBRUARY (1)	FEBRUARY (2)	MARCH (1)	MARCH (2)	APRIL (1)	APRIL (2)	MAY (1)	MAY (2)	JUNE (1)	JUNE (2)	JULY (1)	JULY (2)	AUGUST (1)	AUGUST (2)	SEPTEMBER (1)	SEPTEMBER (2)	OCTOBER (1)	OCTOBER (2)	NOVEMBER (1)	NOVEMBER (2)	DECEMBER (1)	DECEMBER (2)	NORMAL MEAN AVERAGE	
Belknap Springs Sec. 11,T. 16 S.,R. 6 E.	2152'	1961-72	32.4	13.71	37.0	8.57	38.9	7.51	43.8	4.82	51.4	3.41	59.1	1.96	64.6	0.52	64.8	1.01	58.1	2.83	48.7	6.53	40.9	11.67	33.2	13.51	47.8	76.05
Cascadia State Park Sec. 32,T. 13 S.,R. 3 E.	850'	1931-72	37.0	8.88	41.0	6.66	43.5	7.04	48.1	4.96	53.5	3.84	59.6	2.91	64.2	0.58	64.4	0.93	59.3	2.31	50.4	5.67	43.6	8.24	38.9	9.38	50.3	61.40
Cougar Dam Sec. 32,T. 16 S., R.5 E.	1262'	1960-72	-	15.09	-	11.05	-	9.78	-	6.70	-	4.25	-	2.08	-	0.49	-	1.38	-	2.93	-	4.89	-	11.79	-	13.64	-	84.07
Detroit Dam Sec. 7, T.10 S., R.5 E.	1300'	1954-72	37.4	14.16	41.7	9.50	43.0	9.91	46.5	6.77	53.7	4.47	60.4	2.89	66.1	0.63	66.8	1.40	61.0	3.56	52.6	7.53	44.1	12.85	38.5	14.19	50.9	87.86
Detroit, Oregon Sec. 1, T.10 S., R.5 E.	1586'	1931-72	33.7	12.26	37.7	9.21	40.6	8.78	46.6	5.38	53.0	3.72	58.3	2.63	64.0	0.56	63.3	1.04	58.5	2.79	50.3	7.18	41.3	11.58	36.3	13.37	48.6	78.50
Eugene, Oregon	359'	1931-72	40.1	7.22	43.2	4.84	45.8	4.56	50.1	2.57	56.3	2.11	57.9	1.43	66.3	0.27	66.0	0.59	60.9	1.44	53.2	3.83	45.9	5.81	40.9	7.38	52.2	42.05
Foster, Oregon Sec.27, T.13 S., R.1 E.	720'	1963-72	40.5	11.54	43.5	5.60	45.8	6.27	47.7	5.81	54.4	2.81	59.6	1.98	65.7	0.07	65.6	0.34	58.4	2.31	53.5	3.15	45.9	5.18	40.3	9.55	51.7	54.61
Hills Crk. Dam Sec.35, T.21 S., R. 3 E.	1275'	1960-72	-	6.94	-	4.13	-	4.51	-	3.30	-	2.80	-	1.81	-	0.19	-	0.51	-	1.57	-	3.42	-	6.51	-	7.11	-	42.80
Leaburg Dam Sec.31, T.16 S., R. 2 E.	675'	1933-72	39.8	8.92	43.4	7.12	46.0	6.78	51.0	4.53	56.5	3.44	61.5	2.83	66.9	0.60	66.4	0.86	62.3	2.28	53.8	5.71	45.7	8.73	41.2	9.63	52.9	61.43
Lookout Point Dam Sec. 13,T. 19 S.,R. 1 W.	712'	1955-72	40.8	7.55	45.0	4.80	46.6	5.00	49.4	3.34	55.2	3.28	61.4	2.07	66.7	0.36	67.2	0.78	62.0	1.76	55.4	3.68	47.4	6.17	41.9	6.99	53.2	45.78
Lowell 1-E Sec. 15,T. 19 S.,R. 1 W.	1010'	1946-55	-	6.58	-	4.36	-	4.80	-	2.87	-	2.53	-	2.57	-	0.38	-	0.78	-	1.35	-	5.16	-	5.67	-	7.77	-	44.82
Lowell 2-N Sec. 15,T. 19 S.,R. 1 W.	740'	1951-59	-	7.08	-	5.48	-	4.89	-	2.95	-	3.22	-	2.86	-	0.23	-	0.74	-	1.10	-	4.55	-	4.88	-	8.28	-	46.26
Marion Fks. Fish Hatchery Sec. 15,T. 11 S.,R. 7 E.	2425'	1951-72	31.2	12.03	34.8	7.53	37.0	8.36	42.6	4.60	50.7	3.31	57.6	2.08	63.5	0.58	62.0	1.17	55.5	2.42	46.9	5.92	37.8	10.13	32.8	10.71	46.0	68.84
McCredie Springs Sec. 36,T. 31 S.,R. 4 E.	2121'	1944-50	33.0	7.04	36.5	6.47	40.8	5.73	48.2	3.48	54.1	3.44	58.5	2.76	63.9	0.95	64.0	0.51	58.4	2.06	48.0	4.27	39.0	7.47	34.7	5.99	48.3	50.17
McKenzie Ranger Station Sec. 18,T. 16 S.,R. 6 E.	1375'	1931-72	35.2	11.27	39.8	8.04	42.9	7.99	48.4	4.69	54.6	3.72	60.2	2.79	65.7	0.51	64.5	0.83	59.5	2.46	51.8	6.37	42.6	9.77	36.8	11.61	50.2	70.05
Oakridge Ranger Station Sec. 11,T. 21 S.,R. 2 E.	1310'	1931-52	38.1	6.40	41.6	4.91	46.7	4.91	52.2	3.17	57.6	2.42	62.0	2.08	68.0	0.47	68.0	0.45	63.9	1.32	55.3	3.98	45.2	5.88	40.3	6.33	53.2	42.32
Oakridge Salmon Hatchery Sec. 15,T. 21 S.,R. 3 E.	1275'	1951-72	37.5	7.87	42.4	4.75	45.4	5.08	49.9	3.06	55.8	3.03	61.6	1.86	67.2	0.31	67.2	0.69	62.1	1.40	53.5	3.67	44.9	6.32	39.1	7.73	52.2	45.77
Quartzville Sec. 29,T. 11 S.,R. 4 E.	823'	1951-60	-	14.76	-	10.54	-	11.18	-	6.28	-	5.05	-	3.24	-	0.58	-	1.31	-	3.07	-	8.58	-	11.30	-	15.55	-	91.44
Santiam Junction Sec. 14,T. 13 S.,R. 7 E.	3990'	1953-65	-	9.71	-	8.44	-	9.28	-	6.00	-	4.32	-	2.50	-	0.62	-	1.36	-	2.44	-	4.77	-	10.69	-	10.84	-	70.97
Santiam Pass Sec. 24,T. 13 S.,R. 7½ E.	4748'	1963-72	27.4	19.77	30.4	6.63	32.0	9.34	34.5	5.98	43.3	3.49	51.2	3.07	58.4	0.91	58.0	1.47	50.5	3.60	41.8	6.56	34.2	12.05	28.1	16.00	40.8	88.87
West Fir, Oregon Sec. 7,T. 21 S.,R. 3 E.	1070'	1940-64	-	6.80	-	5.87	-	5.38	-	3.87	-	3.48	-	1.97	-	0.54	-	0.56	-	1.72	-	4.16	-	6.70	-	7.50	-	48.55

1/ Data compiled from the following sources: Weather Bureau, U.S. Dept. of Commerce; Eugene Water & Electric Board; U.S. Army Corps of Engineers. The above values are summations of various sources of data and may vary slightly from other reported information.

(1) Mean Temperature

(2) Mean Precipitation

APPENDIX II

GEOLOGY

This appendix contains a brief narrative description of the Generalized Geology of the Soil Resource Inventory area. Also included in this appendix is a Generalized Bedrock Map of the survey area.

The reader is encouraged to consult the State of Oregon, Dept. of Geology and Mineral Industries, Portland, Oregon, and various universities within the area to secure the most recent and up-to-date geologic mapping of the Cascade Range.

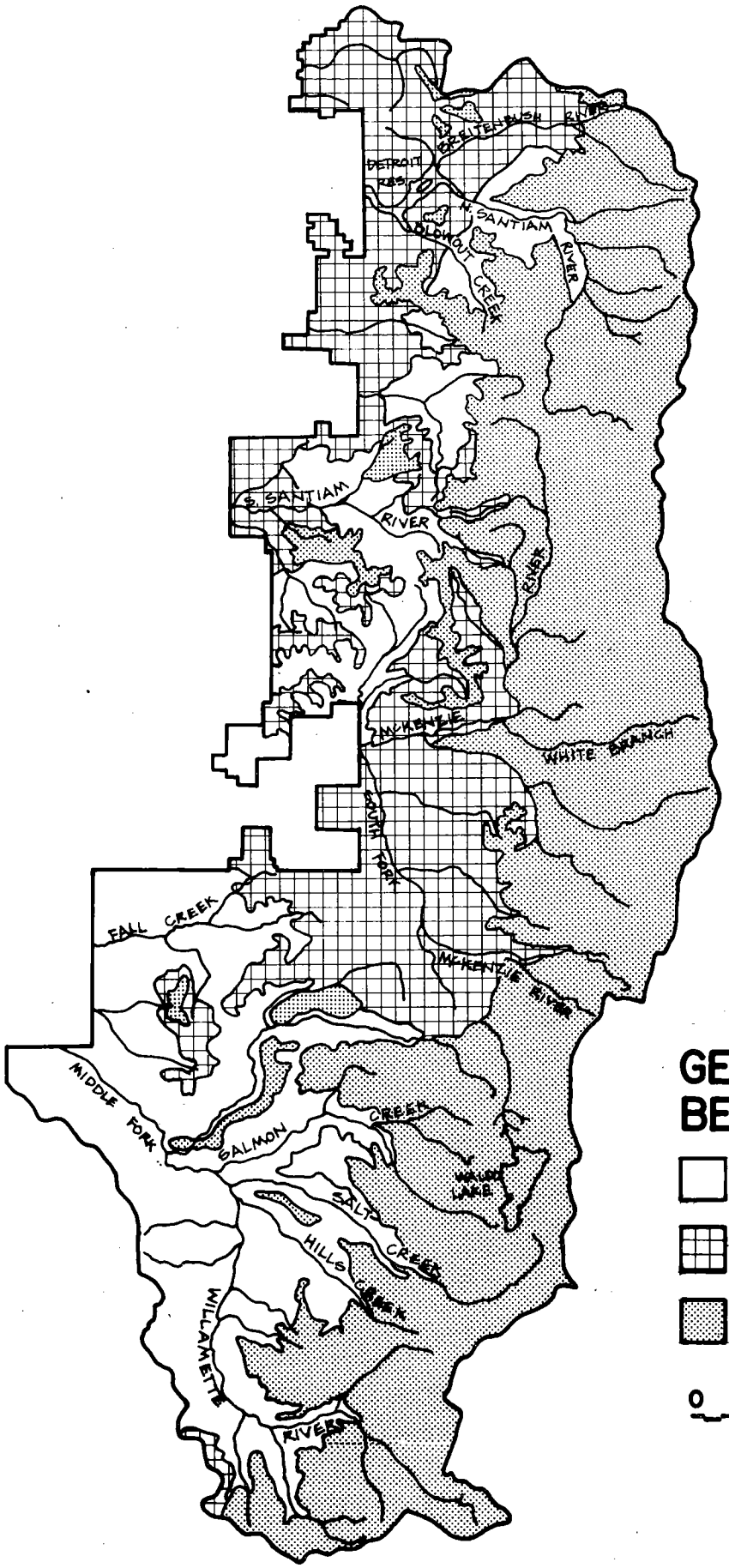

FIGURE 5

GENERALIZED BEDROCK MAP

- LITTLE BUTTE SERIES
- SARDINE FORMATION
- CASCAN FORMATION AND RECENT VOLCANICS

0 5 10 20

GENERALIZED GEOLOGY OF THE SURVEY AREA 1/

The survey area lies within the Cascade Mountain Range and extends from low hills near the Willamette Valley floor to the crest of the Cascade Range. Elevation ranges from near 900 feet on the western boundary to over 10,000 feet at the summit of Mt. Jefferson. Most of the survey area lies below 5500 feet in elevation. Three major drainage systems (Willamette, McKenzie, and Santiam) have all or part of their headwaters within the boundaries of the survey area.

The Cascade Range is asymmetrical in cross-section, and is divided into two physiographic divisions; the High Cascades, and the Western Cascades. The crest of the Cascade Range is called the High Cascades and is located near the eastern boundary of the mountain range. The High Cascades are characterized by gentle constructional volcanic slopes. In contrast, the Western Cascades, which form most of the western slope of the Cascades, are deeply dissected.

The High Cascades are characterized by prominent volcanic cones resting on a plateau of lava flows and shield volcanos. Consequent drainage has developed on the constructional volcanic slopes. Glacial activity has modified many of the volcanic cones, formed lakes, deposited till on the

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1/ The reader is encouraged to consult the following publications for detailed geologic information.

Beaulieu, J.D., 1971, "Geologic formations of Western Oregon," Bulletin 70, State of Oregon, Dept. of Geology & Mineral Industries.

Baldwin, E.M., 1964, "Geology of Oregon," University of Oregon.

Peck, D.L., Griggs, A.B., Schlicker, H.G., Wells, F.G., and Dole, H.M., 1964, Geology of the Central & Northern Parts of the Western Cascade Range in Oregon: U.S. Geol. Survey Prof. Paper 449.

plateau, and widened and deepened most of the stream valleys. Recent volcanic activity has left deposits of volcanic ash, sands, cinders, and pumice in many areas of the High Cascades.

The Western Cascades are characterized by a dendritic drainage pattern developed on tertiary volcanic rocks. Steep narrow stream valleys are separated by acute ridges. Most major stream valleys have been glaciated, at least in their upper parts. Glacial cirque basins are common above 4,500 feet elevation and intracanyon lava flows have flowed down some stream valleys forming low, flat-topped mesas.

Detailed geologic information concerning the Cascade Range, and the survey area in particular, is in short supply. Formations are not well defined, and are distinguished only by broad lithologic differences. Precise contacts, for the most part, are difficult if not impossible to locate. Ages for formations and units are based on fossil leaves and broad stratigraphic relationships. For this reason, the following discussions will deal only in a general way with the major units and formations occurring within the survey area.

WESTERN CASCADES

LITTLE BUTTE VOLCANIC SERIES:

The Little Butte Volcanic Series is composed of some of the oldest rock found in the survey area. The age ranges from early Oligocene to early Miocene. This series is composed of non-marine volcanic rocks consisting of various kinds of reddish colored volcanic tuffs, lapilli tuffs, welded tuffs, breccias, and less abundant flows and small intrusions of andesite, olivine andesite, and olivine basalt. Basaltic and andesitic flow rock

make up no more than 25% of the series. Generally, this series is only gently deformed with low dip angles.

Generally, the volcanic rocks are moderately hard to soft and are slightly fractured to massive. When exposed to weathering, they tend to spall and break down easily. In constrast, the flow rock and intrusives are moderately hard to hard, highly fractured, and resistant to weathering.

Locally, the rock materials of the Little Butte Volcanic Series have been altered by devitrification and propylitization to a greenish color. These rock materials range from hard to saprolitic and tend to be massive and give rise to some of the most unstable materials in the survey area. Deep colluvial and residual soils developing on moderate slopes from these materials are usually high in clay content, cohesive, with rotational and translational failures common in both the soil and bedrock materials. On steep slopes, an intense dissection pattern usually develops, attesting to the massive nature of the bedrock. Suspended sediment derived from the erosion of soil and bedrock materials from areas of greenish tuffs and breccias tend to stay in suspension for long periods of time.

SARDINE FORMATION:

The Sardine Formation is composed of various kinds of andesitic and basaltic flow rock, pyroclastic tuffs and breccias, tuff breccias of mudflow origin, and volcanic sedimentary rocks. The age ranges from mid-Miocene to late Miocene. The reported average thickness of the formation is 3,000 feet.

In general, the bedrock materials within the Sardine Formation are less altered, and exhibit greater stability than those found in the Little Butte Volcanic Series. The flow rock is moderately hard to hard, highly fractured and competent. The tuffaceous volcanic rocks range from moderately hard to

soft, and are moderately to slightly fractured and generally competent. Soils forming from materials of the Sardine Formation tend to be less clayey and more stable than those developing from the Little Butte Volcanic Series. In the field, it was very difficult, if not impossible, to distinguish between the Upper Little Butte Series and Lower Sardine Formation.

During the course of field work, deposits of siltstone were found that the author feels may be significant in the further refinement of the geologic history of the Cascade Range. The siltstone was found intermittently throughout the survey area at the contact between the Sardine and Cascan Formations. The materials were nearly always flat-lying, thin-bedded, and very similar in color and texture.

HIGH CASCADES

CASCADE OR CASCAN FORMATION:

The rocks of the Cascan Formation make up the crest of the Cascade Range. These rocks are composed of porous and porphyritic, gray to black andesite and basalt lava flows. These same rocks comprise the intracanyon lava flows found in the Western Cascades. The age of the Cascan Formation ranges from early Pliocene to Recent. The rocks are uniform in composition, undeformed, hard, moderately to highly fractured, competent, and modified by glaciation. In contrast to the Little Butte Series and Sardine Formation, the topography of the Cascan Formation is constructional rather than erosional.

RECENT VOLCANICS:

The rocks and surficial deposits of the Recent Volcanics are the youngest materials found within the survey area. In contrast to the Cascan Formation, the Recent Volcanics are post-glacial and consist of recent lava flows, ash, sand, cinders, and pumice deposits.

The bedrock materials of the Cascan Formation and Recent Volcanics are very stable but in contrast, the surficial deposits of ash, sand, cinder and pumice are essentially cohesionless and may ravel badly on steep slopes when disturbed.

GLACIATION:

The High Cascades and upper reaches of the Western Cascades have been modified by glaciation. Mt. Jefferson, Mt. Washington, and the Three Sisters are still being sculptured by glaciers today. Cirque basins, hanging valleys, paternoster lakes, and glacial grooves and striations are some of the glacial features readily discernible at the present time.

From field studies of the soil and bedrock materials of the High Casacdes, it appears that after the initial outpourings of lava and formation of mountains such as Mt. Jefferson, Mt. Washington, and Three Sisters, the area was repeatedly glaciated. Following the retreat of glacial activity, a second period of volcanic activity ensued. Pumice from Mt. Mazama (Crater Lake), and deposits of ash, sands, and cinders from local cinder cones buried pre-existing soils developed in glacial materials. Recent lava outpourings occurred in the McKenzie Pass area. All of these surficial deposits overlie existing soils and display very little or no soil development themselves.

APPENDIX III

ENGINEERING TEST DATA

This appendix contains the Engineering Laboratory Test Results of the soil materials from selected landtypes within the Soil Resource Inventory survey area.

All soil material testing and comments made on test results forms were made by the Engineering Materials Section, Willamette National Forest.

The laboratory test data presented in this appendix is intended to be used as a guide and indicator for planning purposes only. The test samples were collected at the landtype type locations.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 12

Location: SE¼,SE¼,Sec.11,T.10 S,R.5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 7-55"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	55.79
Plasticity Index		N.P.	2 1/2	-	#40	52.86
Maximum Density - p.c.f.		86.3	2	100.0	#60	49.92
Optimum Moisture - %		30.3	1 1/2	81.0	#100	46.04
Specific Gravity, #10(-) only		2.76	1	78.0	#200	40.64
California Bearing Ratio	95%	13.4	3/4	74.0	Dia. MM 1/	
	90%	7.4	1/2	74.0	0.0335	18.09
	85%	-	3/8	73.0	0.0218	12.93
pH		6.5	#4	69.0	0.0128	8.92
Resistivity - ohm cm		2,532	#10	59.0	0.0092	5.48
Classification	Mechanical	Hydrometer	#40	38.0	0.0065	3.76
AASHO	A-1-b(o)	A-4 (o)	#100	25.0	0.0032	0.32
UNIFIED	SM-d	GM-d	#200	18.8		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures. Material breaks down when saturated as shown by hydrometer analysis.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 13

Location: SW¼, SE¼, Sec. 29, T. 14 S., R. 6 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0-125"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	41.83
Plasticity Index		N.P.	2 1/2	-	#40	34.84
Maximum Density - p.c.f.		79.9	2	-	#60	28.74
Optimum Moisture - %		31.8	1 1/2	100.0	#100	23.69
Specific Gravity, #10(-) only		2.66	1	92.0	#200	18.45
California Bearing Ratio	95%	26.1	3/4	80.0	Dia. MM 1/	
	90%	12.0	1/2	74.0	0.0362	8.61
	85%		3/8	72.0	0.0233	5.29
pH		5.4	#4	63.0	0.0136	3.08
Resistivity - ohm cm		22,905	#10	50.0	0.0097	0.31
Classification	Mechanical	Hydrometer	#40	31.0		
AASHO	A-1-b(o)	A-1-b(o)	#100	19.0		
UNIFIED	SM-d	SM-d	#200	13.3		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 14A

Location: NW¼, NW¼, Sec. 23, T. 19S, R. 4 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0-20"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		44.7	3		#20	73.11
Plasticity Index		N.P.	2 1/2		#40	66.30
Maximum Density - p.c.f.		87.1	2		#60	60.72
Optimum Moisture - %		28.2	1 1/2	100.0	#100	55.82
Specific Gravity, #10(-) only		2.62	1	97.0	#200	50.79
California Bearing Ratio	95%	9.5	3/4	97.0	Dia. MM 1/	
	90%	5.6	1/2	97.0	0.0311	40.46
	85%		3/8	97.0	0.0201	36.36
pH		5.4	#4	94.0	0.0121	28.17
Resistivity - ohm cm		15,000	#10	79.0	0.0086	24.64
Classification	Mechanical	Hydrometer	#40	61.0	0.0061	21.91
AASHO	A-5(o)	A-5(o)	#100	52.0	0.0031	15.76
UNIFIED	SM-u	ML	#200	48.1	0.0013	10.29

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics and is somewhat plastic. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 14B

Location: NW¼, NW¼, Sec. 23, T. 19S, R. 4 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 20-98"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		51.4	3		#20	64.60
Plasticity Index		N.P.	2 1/2	100.0	#40	61.28
Maximum Density - p.c.f.		85.4	2	88.0	#60	58.58
Optimum Moisture - %		31.7	1 1/2	88.0	#100	55.88
Specific Gravity, #10(-) only		2.67	1	86.0	#200	52.69
California Bearing Ratio	95%	5.6	3/4	85.0	Dia. MM 1/	
	90%	2.3	1/2	84.0	0.0287	45.85
	85%		3/8	82.0	0.0189	39.75
pH		5.0	#4	78.0	0.0113	33.66
Resistivity - ohm cm		14,323	#10	70.0	0.0081	29.90
Classification	Mechanical	Hydrometer	#40	45.0	0.0059	25.64
AASHO	A-2-5(o)	A-5(1)	#100	33.0	0.0030	19.29
UNIFIED	SM-u	SM-u	#200	27.8	0.0012	13.45

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics and is somewhat plastic. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

Soil breaks down when saturated as shown by hydrometer analysis.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 15

Location: NE¼, NE¼, Sec. 31, T. 16 S, R. 5 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 2½-120"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	37.78
Plasticity Index		N.P.	2 1/2	-	#40	30.33
Maximum Density - p.c.f.		106.3	2	100.0	#60	23.92
Optimum Moisture - %		17.4	1 1/2	76.0	#100	16.68
Specific Gravity, #10(-) only		2.68	1	72.0	#200	8.92
California Bearing Ratio	95%	-	3/4	71.0	Dia. MM 1/	
	90%	-	1/2	66.0	0.0309	24.88
	85%	-	3/8	62.0	0.0202	20.90
pH		6.6	#4	53.0	0.0121	16.03
Resistivity - ohm cm		6,871	#10	45.0	0.0088	12.56
Classification	Mechanical	Hydrometer	#40	32.0	0.0063	10.35
AASHO	A-1-b(o)	A-1-b(o)	#100	24.0	0.0032	6.88
UNIFIED	GM-d	GW-GM	#200	18.0	0.0013	4.23

Remarks: This material is a silty gravel with poor drainage characteristics and should make good subgrade. The soil has a medium frost action potential and a good erosion resistance whan used as drainage structure.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 16A

Location: SW¼, SE¼, Sec. 11, T. 16 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0-27"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	38.04
Plasticity Index		N.P.	2 1/2	-	#40	31.96
Maximum Density - p.c.f.		84.2	2	-	#60	27.41
Optimum Moisture - %		29.6	1 1/2	100.0	#100	23.37
Specific Gravity, #10(-) only		2.60	1	90.0	#200	19.23
California Bearing Ratio	95%	12.4	3/4	83.0	Dia. MM 1/	
	90%	9.8	1/2	76.0	0.0358	11.85
	85%		3/8	71.0	0.0229	8.53
pH		6.6	#4	61.0	0.0135	4.82
Resistivity - ohm cm		22,905	#10	46.0	0.0096	2.89
Classification	Mechanical	Hydrometer	#40	27.0	0.0068	0.57
AASHO	A-1-a(o)	A-1-b(o)	#100	19.0		
UNIFIED	SM-d	SM-d	#200	14.8		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 16B

			Mechanical Analysis		Hydrometer Analysis	
Location: SW¼,SE¼,Sec.11,T.16 S.,R.5 E			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 27-90"						
Liquid Limit:		57.6	3	-	#20	30.73
Plasticity Index		11.0	2 1/2	-	#40	27.07
Maximum Density - p.c.f.		94.3	2	100.0	#60	24.68
Optimum Moisture - %		25.6	1 1/2	89.0	#100	22.57
Specific Gravity, #10(-) only		2.70	1	86.0	#200	20.32
California Bearing Ratio	95%	10.1	3/4	79.0	Dia. MM 1/	
	90%	5.5	1/2	72.0	0.0354	7.88
	85%	-	3/8	64.0	0.0225	6.09
pH		6.6	#4	48.0	0.0131	4.70
Resistivity - ohm cm		-	#10	35.0	0.0094	3.32
Classification	Mechanical	Hydrometer	#40	23.0	0.0067	1.93
AASHO	A-2-7(o)	A-2-7(o)	#100	17.0	0.0033	0.19
UNIFIED	GM-u	GM-u	#200	13.3		

Remarks: This material is a silty gravel with very poor drainage characteristics and should make a good subgrade when not subject to frost action. The soil has a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 19

Location: Corner Sec.'s 17,18,19,20,T.14 S.,R.6 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0-78"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	42.57
Plasticity Index		N.P.	2 1/2	100.0	#40	36.95
Maximum Density - p.c.f.		79.7	2	79.0	#60	31.88
Optimum Moisture - %		31.6	1 1/2	75.0	#100	26.72
Specific Gravity, #10(-) only		2.66	1	67.0	#200	20.64
California Bearing Ratio	95%	-	3/4	66.0	Dia. MM 1/	
	90%	-	1/2	62.0	0.0364	7.67
	85%	-	3/8	60.0	0.0236	4.00
pH		5.4	#4	54.0	0.0140	0.87
Resistivity - ohm cm		-	#10	46.0		
Classification	Mechanical	Hydrometer	#40	29.0		
AASHO	A-1-a(o)	A-1-b(o)	#100	20.0		
UNIFIED	GM-d	GM-d	#200	14.9		

Remarks: This material is a silty gravel with poor drainage characteristics and should make good subgrade. The soil has a medium frost action potential and a good erosion resistance when used as drainage structure.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 21

Location: SE¼, NW¼, Sec. 19, T. 19 S, R. 2 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 13 - 36"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3		#20	81.44
Plasticity Index		N.P.	2 1/2	100.0	#40	77.11
Maximum Density - p.c.f.		98.4	2	88.0	#60	72.50
Optimum Moisture - %		23.5	1 1/2	88.0	#100	66.38
Specific Gravity, #10(-) only		2.83	1	88.0	#200	57.33
California Bearing Ratio	95%	5.9	3/4	87.0	Dia. MM 1/	
	90%	2.7	1/2	85.0	0.0278	18.87
	85%		3/8	84.0	0.0185	15.48
pH		6.6	#4	80.0	0.0111	12.19
Resistivity - ohm cm		2,290	#10	77.0	0.0080	10.21
Classification	Mechanical	Hydrometer	#40	66.0	0.0058	8.12
AASHO	A-4 (o)	A-4 (o)	#100	53.0	0.0029	5.76
UNIFIED	SM-d	ML	#200	41.1	0.0012	3.63

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures. Material breaks down when saturated as shown by hydrometer analysis.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 22A

			Mechanical Analysis		Hydrometer Analysis	
Location: NE¼, SW¼, Sec. 22, T. 19 S., R. 2 E			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 0 - 8"			3		#20	73.47
Liquid Limit:		56.0	2 1/2		#40	67.54
Plasticity Index		11.0	2		#60	60.66
Maximum Density - p.c.f.		72.0	1 1/2	100.0	#100	53.05
Optimum Moisture - %		35.8	1	94.0	#200	46.09
Specific Gravity, #10(-) only		2.59	3/4	93.0	Dia. MM 1/	
California Bearing Ratio	95%	8.2	1/2	90.0	0.0262	36.71
	90%	5.0	3/8	88.0	0.0174	33.01
	85%		#4	83.0	0.0107	29.00
pH		4.8	#10	77.0	0.0078	26.04
Resistivity - ohm cm		4,646	#40	64.0	0.0056	23.82
Classification	Mechanical	Hydrometer	#100	50.0	0.0029	17.90
AASHO	A-7-5(2)	A-7-5(3)	#200	42.6	0.0013	11.67
UNIFIED	SM-u	SM-u				

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics and is somewhat plastic. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures. Soil is acid; estimated life of 16-gage culvert pipe is 15 years to perforation.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 22B

Location: NE¼,SW¼,Sec.22,T.19 S.,R.2 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 8 - 38"+			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		63.9	3		#20	90.11
Plasticity Index		19.0	2 1/2		#40	85.94
Maximum Density - p.c.f.		82.0	2		#60	80.15
Optimum Moisture - %		31.5	1 1/2	100.0	#100	70.73
Specific Gravity, #10(-) only		2.59	1	97.0	#200	60.86
California Bearing Ratio	95%	8.4	3/4	96.0	Dia. MM 1/	
	90%	3.0	1/2	96.0	0.0247	49.99
	85%		3/8	96.0	0.0162	47.24
pH		4.8	#4	95.0	0.0099	41.75
Resistivity - ohm cm		29,535	#10	93.0	0.0074	37.71
Classification	Mechanical	Hydrometer	#40	88.0	0.0053	34.96
AASHO	A-7-5(14)	A-7-5(12)	#100	75.0	0.0028	28.56
UNIFIED	MH	MH	#200	63.7	0.0012	20.78

Remarks: This material is a "high silt", inorganic micaceous or diatomaceous fine sandy or silty soils, which are elastic. It makes a poor subgrade material, frost susceptibility is high; it is highly compressible and is expansive. Drainage characteristics are poor. It is a poor construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 23

Location: NE¼, SW¼, Sec. 35, T. 20 S., R. 3 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 8 - 62"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		46.0	3		#20	83.70
Plasticity Index		14.0	2 1/2		#40	78.40
Maximum Density - p.c.f.		96.4	2		#60	74.71
Optimum Moisture - %		24.7	1 1/2	100.0	#100	71.35
Specific Gravity, #10(-) only		2.70	1	96.0	#200	67.34
California Bearing Ratio	95%	7.6	3/4	96.0	Dia. MM 1/	
	90%	4.4	1/2	95.0	0.0281	61.90
	85%		3/8	95.0	0.0184	54.78
pH		5.2	#4	93.0	0.0108	49.11
Resistivity - ohm cm		8,907	#10	88.0	0.0078	45.95
Classification	Mechanical	Hydrometer	#40	71.0	0.0056	40.41
AASHO	A-7-5(6)	A-7-5(10	#100	59.0	0.0028	33.29
UNIFIED	ML	ML	#200	53.3	0.0012	25.37

Remarks: This material is an inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity. Value as a subgrade is poor to fair, high frost susceptibility, slight to medium compressibility and expansion characteristics will be found. Drainage characteristics are fair to poor. Soil has fair workability as a construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 25A

Location: NW¼,SE¼,Sec.25,T.22 S.,R.4 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 15"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		40.8	3		#20	81.98
Plasticity Index		11.0	2 1/2		#40	76.70
Maximum Density - p.c.f.		92.6	2		#60	72.78
Optimum Moisture - %		25.0	1 1/2	100.0	#100	68.79
Specific Gravity, #10(-) only		2.66	1	96.0	#200	62.95
California Bearing Ratio	95%	10.6	3/4	95.0	Dia. MM 1/	
	90%	5.4	1/2	94.0	0.0314	22.43
	85%		3/8	93.0	0.0203	20.04
pH		5.4	#4	91.0	0.0121	15.83
Resistivity - ohm cm		14,576	#10	86.0	0.0086	14.01
Classification	Mechanical	Hydrometer	#40	75.0	0.0062	10.99
AASHO	A-7-5(6)	A-7-5(6)	#100	67.0	0.0031	7.18
UNIFIED	ML	ML	#200	61.4	0.0013	3.74

Remarks: This material is an inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity. Value as a subgrade is poor to fair, high frost susceptibility, slight to medium compressibility and expansion characteristics will be found. Drainage characteristics are fair to poor. Soil has fair workability as a construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 25B

Location: NW¼, SE¼, Sec. 25, T. 22S., R. 4 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 15 - 75"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		40.0	3		#20	88.10
Plasticity Index		12.0	2 1/2		#40	85.14
Maximum Density - p.c.f.		88.4	2		#60	82.34
Optimum Moisture - %		29.2	1 1/2	100.0	#100	78.88
Specific Gravity, #10(-) only		2.72	1	99.0	#200	73.78
California Bearing Ratio	95%	3.0	3/4	97.0	Dia. MM 1/	
	90%	1.6	1/2	96.0	0.0284	60.07
	85%		3/8	94.0	0.0186	52.79
pH		6.6	#4	93.0	0.0110	46.18
Resistivity - ohm cm		22,400	#10	90.0	0.0080	40.52
Classification	Mechanical	Hydrometer	#40	83.0	0.0058	34.85
AASHO	A-6(8)	A-6(9)	#100	76.0	0.0029	27.57
UNIFIED	ML	ML	#200	70.7	0.0012	20.29

Remarks: This material is an inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayer silts with slight plasticity. Value as a subgrade is poor to fair, high frost susceptibility, slight to medium compressibility and expansion characteristics will be found. Drainage characteristics are fair to poor. Soil has fair workability as a construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 31

Location: NE¼,NE¼,Sec.7,T.23 S.,R.3 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 33"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		30.2	3	-	#20	34.52
Plasticity Index		N.P.	2 1/2	100.0	#40	27.82
Maximum Density - p.c.f.		102.3	2	87.0	#60	23.59
Optimum Moisture - %		20.0	1 1/2	87.0	#100	20.56
Specific Gravity, #10(-) only		2.66	1	85.0	#200	17.91
California Bearing Ratio	95%	17.1	3/4	81.0	Dia. MM 1/	
	90%	2.7	1/2	75.0	0.0360	11.00
	85%	-	3/8	69.0	0.0228	9.72
pH		6.6	#4	55.0	0.0132	7.62
Resistivity - ohm cm		6,871	#10	41.0	0.0093	6.33
Classification	Mechanical	Hydrometer	#40	27.0	0.0066	4.70
AASHO	A-1-b(o)	A-1-b(o)	#100	20.0	0.0033	0.63
UNIFIED	GM-u	GM-u	#200	17.6		

Remarks: This material is a silty gravel with very poor drainage characteristics and should make a good subgrade when not subject to frost action. The soil has a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 33A

Location: SW¼,NW¼,Sec.20,T.19 S.,R.2 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 5 - 24"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		38.9	3		#20	53.74
Plasticity Index		6.0	2 1/2	100.0	#40	47.19
Maximum Density - p.c.f.		101.3	2	85.0	#60	42.09
Optimum Moisture - %		20.6	1 1/2	75.0	#100	37.94
Specific Gravity, #10(-) only		2.59	1	74.0	#200	34.31
California Bearing Ratio	95%	8.4	3/4	72.0	Dia. MM 1/	
	90%	3.8	1/2	71.0	0.0256	30.20
	85%		3/8	69.0	0.0169	27.83
pH		5.2	#4	65.0	0.0102	24.87
Resistivity - ohm cm		14,147	#10	59.0	0.0075	22.85
Classification	Mechanical	Hydrometer	#40	48.0	0.0056	19.64
AASHO	A-4(o)	A-2-4(o)	#100	39.0	0.0029	14.32
UNIFIED	GM-u	GM-u	#200	35.3	0.0013	8.70

Remarks: This material is a silty gravel with very poor drainage characteristics and should make a good subgrade when not subject to frost action. The soil has a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 33B

Location: Center of Sections 4 & 5 T. 19 S., R. 2 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 24 - 45			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		41.1	3	-	#20	61.23
Plasticity Index		12.0	2 1/2	100.0	#40	56.52
Maximum Density - p.c.f.		86.4	2	86.0	#60	51.59
Optimum Moisture - %		29.4	1 1/2	86.0	#100	46.80
Specific Gravity, #10(-) only		2.68	1	80.0	#200	41.52
California Bearing Ratio	95%	7.4	3/4	77.0	Dia. MM 1/	
	90%	0.6	1/2	76.0	0.0337	28.51
	85%		3/8	74.0	0.0215	25.25
pH		5.3	#4	69.0	0.0125	21.98
Resistivity - ohm cm		5,404	#10	64.0	0.0090	18.18
Classification	Mechanical	Hydrometer	#40	52.0	0.0063	17.44
AASHO	A-2-7(o)	A-7(2)	#100	40.0	0.0031	12.38
UNIFIED	SM-u	GM-u	#200	33.7	0.0013	7.32

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics and is somewhat plastic. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 35A

Location: Center of Sections 4 & 5 T. 19 S., R. 2 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 14"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		52.6	3		#20	88.12
Plasticity Index		N. P.	2 1/2		#40	84.02
Maximum Density - p.c.f.		81.6	2		#60	80.10
Optimum Moisture - %		33.1	1 1/2	100.0	#100	76.35
Specific Gravity, #10(-) only		2.67	1	97.0	#200	72.61
California Bearing Ratio	95%	6.4	3/4	96.0	Dia. MM 1/	
	90%	2.4	1/2	96.0	0.0290	64.84
	85%		3/8	95.0	0.0187	59.89
pH		5.2	#4	93.0	0.0110	53.18
Resistivity - ohm cm		9,918	#10	91.0	0.0080	47.87
Classification	Mechanical	Hydrometer	#40	81.0	0.0057	44.33
AASHO	A-5(4)	A-5(4)	#100	72.0	0.0028	37.24
UNIFIED	MH	MH	#200	68.4	0.0012	29.13

Remarks: This material is a "high silt", inorganic micaceous or diatomaceous fine sandy or silty soils, which are elastic. It makes a poor subgrade material, frost susceptibility is high; it is highly compressible, and is expansive. Drainage characteristics are poor. It is a poor construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 35B

Location: Center of Sections 4 & 5 T.19 S., R.2 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 14 - 80" +			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		60.4	3		#20	90.76
Plasticity Index		19.0	2 1/2		#40	86.87
Maximum Density - p.c.f.		83.2	2		#60	82.35
Optimum Moisture - %		33.8	1 1/2		#100	77.20
Specific Gravity, #10(-) only		2.69	1	100.0	#200	72.06
California Bearing Ratio	95%	10.0	3/4	99.0	Dia. MM 1/	
	90%	5.8	1/2	98.0	0.0279	61.81
	85%		3/8	97.0	0.0183	54.87
pH		5.8	#4	94.0	0.0109	49.48
Resistivity - ohm cm		15,719	#10	91.0	0.0079	43.19
Classification	Mechanical	Hydrometer	#40	83.0	0.0056	40.11
AASHO	A-7-5(16)	A-7-5(16)	#100	74.0	0.0028	33.95
UNIFIED	MH	MH	#200	69.8	0.0012	25.47

Remarks: This material is a "high silt", inorganic micaceous or diatomaceous fine sandy or silty soils, which are elastic. It makes a poor subgrade material, frost susceptibility is high, it is highly compressible and is expansive. Drainage characteristics are poor. It is a poor construction material. Erosion potential is very high.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 44

Location: SE¼, SE¼, Sec. 23, T. 20 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 3 - 54"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	100.0	#20	36.41
Plasticity Index		N.P.	2 1/2	79.0	#40	29.69
Maximum Density - p.c.f.		-	2	79.0	#60	25.42
Optimum Moisture - %		-	1 1/2	72.0	#100	22.47
Specific Gravity, #10(-) only		2.48	1	67.0	#200	19.35
California Bearing Ratio	95%	-	3/4	66.0	Dia. MM 1/	
	90%	-	1/2	60.0	0.0381	7.69
	85%		3/8	56.0	0.0246	4.19
pH		6.4	#4	52.0	0.0143	1.05
Resistivity - ohm cm		11,318	#10	42.0	0.0102	-0.69
Classification	Mechanical	Hydrometer	#40	19.0		
AASHO	A-1-a(o)	A-1-b(o)	#100	-		
UNIFIED	GW-GM-d	GM-d	#200	5.0		

Remarks: This material is a well graded silty gravel with fair drainage characteristics and should make an excellent subgrade. The soil has a slight frost action potential and a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 55A

Location: NW¼, NE¼, Sec. 20, T. 11 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0-10"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	50.32
Plasticity Index		N.P.	2 1/2	-	#40	44.66
Maximum Density - p.c.f.		73.1	2	100.0	#60	39.32
Optimum Moisture - %		37.4	1 1/2	92.0	#100	34.23
Specific Gravity, #10(-) only		2.52	1	86.0	#200	28.74
California Bearing Ratio	95%	12.2	3/4	83.0	Dia. MM 1/	
	90%	5.2	1/2	80.0	0.0372	12.50
	85%	-	3/8	77.0	0.0240	7.86
pH		5.0	#4	68.0	0.0144	4.58
Resistivity - ohm cm		-	#10	56.0	0.0101	2.74
Classification	Mechanical	Hydrometer	#40	34.0	0.0072	0.33
AASHO	A-1-b(o)	A-2-4(o)	#100	20.0		
UNIFIED	SM-d	SM-d	#200	13.4		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 55B

Location: NW¼, NE¼, Sec. 20, T. 11 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 10 - 36			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	47.76
Plasticity Index		N.P.	2 1/2	-	#40	43.24
Maximum Density - p.c.f.		82.6	2	100.0	#60	38.56
Optimum Moisture - %		31.6	1 1/2	93.0	#100	34.02
Specific Gravity, #10(-) only		2.62	1	87.0	#200	29.50
	95%	15.8	3/4	83.0	Dia. MM 1/	
California Bearing Ratio	90%	9.4	1/2	76.0	0.0351	15.39
	85%		3/8	71.0	0.0229	11.83
pH		5.2	#4	62.0	0.0134	9.23
Resistivity - ohm cm		-	#10	52.0	0.0095	6.02
Classification	Mechanical	Hydrometer	#40	34.0	0.0068	3.94
AASHO	A-1-b(o)	A-2-4(o)	#100	20.0	0.0033	0.21
UNIFIED	SM-d	GM-d	#200	14.2		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 55C

			Mechanical Analysis		Hydrometer Analysis	
Location: NW¼, NE¼, Sec. 20, T. 11 S., R. 5 E			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 36 - 52"+						
Liquid Limit:		53.9	3	-	#20	73.94
Plasticity Index		N.P.	2 1/2	-	#40	68.77
Maximum Density - p.c.f.		86.5	2	-	#60	61.60
Optimum Moisture - %		29.4	1 1/2	100.0	#100	51.49
Specific Gravity, #10(-) only		2.72	1	99.0	#200	41.37
California Bearing Ratio	95%	10.6	3/4	97.0	Dia. MM 1/	
	90%	5.0	1/2	95.0	0.0345	23.64
	85%		3/8	-	0.0223	17.06
pH		5.0	#4	86.0	0.0131	12.12
Resistivity - ohm cm		5,938	#10	78.0	0.0092	9.52
Classification	Mechanical	Hydrometer	#40	63.0	0.0066	4.58
AASHO	A-2-5(o)	A-5(o)	#100	45.0		
UNIFIED	SM-u	SM-u	#200	34.2		

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics and is somewhat plastic. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 56A

Location: SE¼, SW¼, SEC.34, T.22 S, R.5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 12 - 29"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	44.36
Plasticity Index		N.P.	2 1/2	-	#40	36.51
Maximum Density - p.c.f.		-	2	100.0	#60	32.01
Optimum Moisture - %		-	1 1/2	86.0	#100	27.30
Specific Gravity, #10(-) only		2.73	1	74.0	#200	19.67
California Bearing Ratio	95%	-	3/4	72.0	Dia. MM 1/	
	90%	-	1/2	70.0	0.0355	7.99
	85%	-	3/8	68.0	0.0231	2.34
pH		7.0	#4	62.0	0.0132	1.74
Resistivity - ohm cm		-	#10	52.0	0.0093	1.66
Classification	Mechanical	Hydrometer	#40	31.0	0.0066	0.12
AASHO	A-1-b(o)	A-1-b(o)	#100	19.0		
UNIFIED	SW-SM-d	SM-d	#200	10.2		

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 56B

Location: SE¼, SW¼, Sec. 34, T. 22 S, R. 5 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 29 - 38"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	38.20
Plasticity Index		N.P.	2 1/2	-	#40	33.57
Maximum Density - p.c.f.		-	2	-	#60	30.05
Optimum Moisture - %		-	1 1/2	100.0	#100	25.75
Specific Gravity, #10(-) only		2.79	1	86.0	#200	18.37
California Bearing Ratio	95%	-	3/4	76.0	Dia. MM 1/	
	90%	-	1/2	68.0	0.0344	8.15
	85%	-	3/8	63.0	0.0221	4.33
pH		6.8	#4	53.0	0.0130	1.83
Resistivity - ohm cm		-	#10	43.0	0.0092	1.00
Classification	Mechanical	Hydrometer	#40	29.0	0.0065	0.16
AASHO	A-1-a(o)	A-1-b(o)	#100	19.0		
UNIFIED	GP-GM-d	GM-d	#200	11.5		

Remarks: This material is a silty gravel with poor drainage characteristics and should make good subgrade. The soil has a medium frost action potential and a good erosion resistance when used as drainage structure.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No.61

			Mechanical Analysis		Hydrometer Analysis	
Location: NE¼,SW¼,Sec.8,T.16 S. R.5 E			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 0 - 20"						
Liquid Limit:		36.7	3	-	#20	61.68
Plasticity Index		N.P.	2 1/2	100.0	#40	53.55
Maximum Density - p.c.f.		101.2	2	88.0	#60	47.91
Optimum Moisture - %		19.6	1 1/2	88.0	#100	41.30
Specific Gravity, #10(-) only		2.68	1	81.0	#200	30.84
California Bearing Ratio	95%	8.3	3/4	81.0	Dia. MM 1/	
	90%	3.4	1/2	79.0	0.0327	31.08
	85%		3/8	78.0	0.0211	26.98
pH		6.6	#4	75.0	0.0124	20.73
Resistivity - ohm cm		4,625	#10	69.0	0.0089	18.01
Classification	Mechanical	Hydrometer	#40	54.0	0.0063	13.12
AASHO	A-2-4(o)	A-2-4(o)	#100	44.0	0.0032	5.84
UNIFIED	SM-u	SM-u	#200	34.6		

Remarks: This material is a silty sand or silt-sand mixture with very poor drainage characteristics. It should have fair value as a subgrade except when subjected to frost action. Fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 62

Location: NE¼, NW¼, Sec. 20, T. 13 S., R. 7E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 30"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	26.33
Plasticity Index		N.P.	2 1/2	100.0	#40	21.29
Maximum Density - p.c.f.		-	2	89.0	#60	17.78
Optimum Moisture - %		-	1 1/2	76.0	#100	12.88
Specific Gravity, #10(-) only		2.86	1	67.0	#200	6.58
California Bearing Ratio	95%	-	3/4	62.0	Dia. MM 1/	
	90%	-	1/2	58.0	0.0356	2.65
	85%	-	3/8	54.0	0.0224	2.26
pH		5.6	#4	47.0	0.0129	1.48
Resistivity - ohm cm		-	#10	35.0	0.0090	1.20
Classification	Mechanical	Hydrometer	#40	23.0	0.0063	1.08
AASHO	A-1-a(o)	A-1-a(o)	#100	11.0	0.0031	1.08
UNIFIED	GW	GW-GM	#200	4.8	0.0013	0.41

Remarks: This material is a well graded silty gravel with fair drainage characteristics and should make an excellent subgrade. The soil has a slight frost action potential and a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 63

Location: SW¼, SW¼, Sec. 2, T. 16 S., R. 6 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 38"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	64.95
Plasticity Index		N.P.	2 1/2	-	#40	57.72
Maximum Density - p.c.f.		65.4	2	-	#60	49.99
Optimum Moisture - %		43.0	1 1/2	-	#100	40.80
Specific Gravity, #10(-) only		2.62	1	100.0	#200	26.47
	95%	15.4	3/4	94.0	Dia. MM 1/	
California Bearing Ratio	90%	11.0	1/2	89.0	0.0375	8.23
	85%		3/8	-		
pH		6.6	#4	80.0		
Resistivity - ohm cm		22,905	#10	70.0		
Classification	Mechanical	Hydrometer	#40	48.0		
AASHO	A-1-b(o)	A-2-4(o)	#100	28.0		
UNIFIED	SM-d	SM-d	#200	15.4		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 64A

Location: SW¼, SE¼, Sec. 28, T. 22S, R. 4 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 23"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	23.00
Plasticity Index		N.P.	2 1/2	100.0	#40	16.40
Maximum Density - p.c.f.		93.8	2	88.0	#60	12.26
Optimum Moisture - %		20.0	1 1/2	83.0	#100	10.13
Specific Gravity, #10(-) only		2.66	1	81.0	#200	8.66
California Bearing Ratio	95%	32.4	3/4	69.0	Dia. MM 1/	
	90%	18.6	1/2	56.0	0.0373	3.13
	85%	-	3/8	48.0	0.0236	2.29
pH		6.4	#4	36.0	0.0136	1.46
Resistivity - ohm cm		-	#10	26.0		
Classification	Mechanical	Hydrometer	#40	12.0		
AASHO	A-1-a(o)	A-1-a(1)	#100	8.0		
UNIFIED	GW-GM-d	GW-GM-d	#200	6.2		

Remarks: This material is a well graded silty gravel with fair drainage characteristics and should make an excellent subgrade. The soil has a slight frost action potential and a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 64B

			Mechanical Analysis		Hydrometer Analysis	
Location: SW¼,SE¼,Sec.28,T.22 S.R.4 E			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 23 - 38"						
Liquid Limit:		48.8	3	-	#20	14.72
Plasticity Index		N.P.	2 1/2	100.0	#40	13.30
Maximum Density - p.c.f.		-	2	84.0	#60	12.52
Optimum Moisture - %		-	1 1/2	54.0	#100	11.86
Specific Gravity, #10(-) only		2.61	1	39.0	#200	10.90
California Bearing Ratio	95%	-	3/4	34.0	Dia. MM 1/	
	90%	-	1/2	26.0	0.0349	6.78
	85%	-	3/8	23.0	0.0225	5.27
pH		5.4	#4	19.0	0.0133	3.42
Resistivity - ohm cm		-	#10	16.0	0.0095	2.24
Classification	Mechanical	Hydrometer	#40	12.0	0.0068	1.58
AASHO	A-1-a(o)	A-1-a(o)	#100	-	0.0034	0.25
UNIFIED	GW-GM-u	GW-GM-u	#200	7.7		

Remarks: This material is a well graded silty gravel with poor drainage characteristics and should make an excellent subgrade. The soil has a slight frost action potential and a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 66

Location: SW¼, SE¼, Sec. 1, T. 14 S., R. 6 E.			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 36"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	78.02
Plasticity Index		N.P.	2 1/2	-	#40	70.95
Maximum Density - p.c.f.		75.3	2	-	#60	59.01
Optimum Moisture - %		31.8	1 1/2	-	#100	41.33
Specific Gravity, #10(-) only		2.67	1	100.0	#200	24.02
California Bearing Ratio	95%	15.0	3/4	99.0	Dia. MM 1/	
	90%	4.6	1/2	97.0	0.0371	4.81
	85%	-	3/8	96.0		
pH		5.4	#4	92.0		
Resistivity - ohm cm		19,713	#10	84.0		
Classification	Mechanical	Hydrometer	#40	67.0		
AASHO	A-2-4(o)	A-2-4(o)	#100	33.0		
UNIFIED	SM-d	SM-d	#200	16.0		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 67

Location: SW¼, SE¼, Sec. 22, T. 16 S., R. 7 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 5 - 32"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	31.62
Plasticity Index		N.P.	2 1/2	100.0	#40	23.79
Maximum Density - p.c.f.		81.2	2	83.0	#60	17.40
Optimum Moisture - %		29.0	1 1/2	73.0	#100	12.53
Specific Gravity, #10(-) only		2.72	1	65.0	#200	9.00
California Bearing Ratio	95%	25.0	3/4	62.0	Dia. MM 1/	
	90%	12.3	1/2	57.0	0.0366	3.40
	85%	-	3/8	--	0.0234	1.84
pH		5.6	#4	47.0	0.0135	0.61
Resistivity - ohm cm		22,905	#10	38.0		
Classification	Mechanical	Hydrometer	#40	23.0		
AASHO	A-1-a(o)	A-1-a(o)	#100	13.0		
UNIFIED	GW-GM-d	GW-GM-d	#200	9.1		

Remarks: This material is a well graded silty gravel with fair drainage characteristics and should make an excellent subgrade. The soil has a slight frost action potential and a good erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 71A

Location: NW¼, NW¼, Sec. 22, T. 19 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 12"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	61.57
Plasticity Index		N.P.	2 1/2	-	#40	48.46
Maximum Density - p.c.f.		-	2	-	#60	39.92
Optimum Moisture - %		-	1 1/2	-	#100	34.32
Specific Gravity, #10(-) only		2.49	1	-	#200	29.90
California Bearing Ratio	95%	-	3/4	100.0	Dia. MM 1/	
	90%	-	1/2	98.0	0.0369	21.05
	85%	-	3/8	96.0	0.0233	18.63
pH		6.6	#4	91.0	0.0136	13.16
Resistivity - ohm cm		-	#10	74.0	0.0097	10.11
Classification	Mechanical	Hydrometer	#40	33.0	0.0069	7.82
AASHO	A-1-b(o)	A-2-4(o)	#100	18.0	0.0034	4.00
UNIFIED	SW-SM-d	SM-d	#200	12.0	0.0014	2.47

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 71B

			Mechanical Analysis		Hydrometer Analysis	
Location NW¼, NW¼, Sec. 22, T. 19 S., R. 5 E.			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 12 - 28"						
Liquid Limit:		N.P.	3	-	#20	
Plasticity Index		N.P.	2 1/2	-	#40	
Maximum Density - p.c.f.		-	2	-	#60	
Optimum Moisture - %		-	1 1/2	100.0	#100	
Specific Gravity, #10(-) only		-	1	97.0	#200	
California Bearing Ratio	95%	-	3/4	96.0	Dia. MM 1/	
	90%	-	1/2	94.0		
	85%	-	3/8	93.0		
pH		-	#4	88.0		
Resistivity - ohm cm		-	#10	75.0		
Classification	Mechanical	Hydrometer	#40	43.0		
AASHO	A-1-b(o)		#100	25.0		
UNIFIED	SM-d		#200	18.6		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 74A

Location: SW¼, NW¼, Sec. 22, T. 19 S., R. 5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 10"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	59.07
Plasticity Index		N.P.	2 1/2	-	#40	46.78
Maximum Density - p.c.f.		-	2	-	#60	38.44
Optimum Moisture - %		-	1 1/2	-	#100	32.64
Specific Gravity, #10(-) only		2.45	1	100.0	#200	27.55
California Bearing Ratio	95%	-	3/4	99.0	Dia. MM 1/	
	90%	-	1/2	96.0	0.0380	20.67
	85%	-	3/8	94.0	0.0242	16.84
pH		6.8	#4	88.0	0.0141	11.53
Resistivity - ohm cm		-	#10	71.0	0.0101	8.57
Classification	Mechanical	Hydrometer	#40	33.0	0.0071	7.70
AASHO	A-1-b(o)	A-2-4(o)	#100	19.0	0.0035	3.88
UNIFIED	SM-d	SM-d	#200	13.5	0.0014	0.05

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 74B

Location: SW¼,NW¼,Sec.22,T.19 S.,R.5 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 10 - 38"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	62.40
Plasticity Index		N.P.	2 1/2	-	#40	50.14
Maximum Density - p.c.f.		-	2	-	#60	41.13
Optimum Moisture - %		-	1 1/2	-	#100	34.79
Specific Gravity, #10(-) only		2.54	1	100.0	#200	29.58
California Bearing Ratio	95%	-	3/4	96.0	Dia. MM 1/	
	90%	-	1/2	95.0	0.0369	17.83
	85%	-	3/8	93.0	0.0233	15.54
pH		5.6	#4	87.0	0.0135	11.82
Resistivity - ohm cm		-	#10	70.0	0.0097	8.94
Classification	Mechanical	Hydrometer	#40	35.0	0.0068	6.66
AASHO	A-1-b(o)	A-2-4(o)	#100	20.0	0.0033	3.77
UNIFIED	SM-d	SM-d	#200	14.8	0.0014	1.49

Remarks: This material is a poorly graded silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 81A

Location: NW¼, NW¼, Sec. 35, T. 13 S., R. 7½ E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 7"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	90.35
Plasticity Index		N.P.	2 1/2	-	#40	69.17
Maximum Density - p.c.f.		-	2	-	#60	46.24
Optimum Moisture - %		-	1 1/2	-	#100	26.61
Specific Gravity, #10(-) only		2.77	1	-	#200	12.43
California Bearing Ratio	95%	-	3/4	-	Dia. MM [1/]	
	90%	-	1/2	-	0.0355	10.94
	85%	-	3/8	100.0	0.0228	5.27
pH		6.6	#4	99.7	0.0130	4.16
Resistivity - ohm cm		22.905	#10	97.0	0.0091	4.01
Classification	Mechanical	Hydrometer	#40	61.0	0.0065	3.06
AASHO	A-3(o)	A-2-4(o)	#100	21.0	0.0032	1.17
UNIFIED	SW-SM-d	SW-SM-d	#200	7.3	0.0013	1.17

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 81B

Location: NW¼, NW¼, Sec. 35, T. 13 S., R. 7½E			Mechanical Analysis		Hydrometer Analysis	
Depth: 7-12"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	89.10
Plasticity Index		N.P.	2 1/2	-	#40	69.94
Maximum Density - p.c.f.		-	2	-	#60	49.82
Optimum Moisture - %		-	1 1/2	-	#100	31.42
Specific Gravity, #10(-) only		2.75	1	-	#200	15.13
	95%	-	3/4	-	Dia. MM 1/	
California Bearing Ratio	90%	-	1/2	100.0	0.0357	10.83
	85%	-	3/8	99.9	0.0229	5.21
pH		6.6	#4	99.6	0.0133	3.34
Resistivity - ohm cm		22,905	#10	96.0	0.0093	4.12
Classification	Mechanical	Hydrometer	#40	51.0	0.0065	0.00
AASHO	A-3(o)	A-2-4(o)	#100	17.0		
UNIFIED	SW-SM-d	SW-SM-d	#200	7.0		

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 81C

Location: NW¼, NW¼, Sec. 35, T. 13 S, R. 7½ E			Mechanical Analysis		Hydrometer Analysis	
Depth: 12 - 29"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	
Plasticity Index		N.P.	2 1/2	-	#40	
Maximum Density - p.c.f.		-	2	-	#60	
Optimum Moisture - %		-	1 1/2	-	#100	
Specific Gravity, #10(-) only		-	1	100.0	#200	
California Bearing Ratio	95%	-	3/4	96.0	Dia. MM 1/	
	90%	-	1/2	90.0		
	85%	-	3/8	88.0		
pH		-	#4	83.0		
Resistivity - ohm cm		-	#10	79.0		
Classification	Mechanical	Hydrometer	#40	53.0		
AASHO	A-2-4(o)		#100	26.0		
UNIFIED	SM-d		#200	18.4		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 82A

Location: SE¼, SW¼, Sec. 26, T. 13 S, R 7½ E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 8"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	86.40
Plasticity Index		N.P.	2 1/2	-	#40	64.29
Maximum Density - p.c.f.		-	2	-	#60	41.64
Optimum Moisture - %		-	1 1/2	-	#100	22.80
Specific Gravity, #10(-) only		2.83	1	-	#200	10.04
California Bearing Ratio	95%	-	3/4	-	Dia. MM 1/	
	90%	-	1/2	-	0.0356	3.27
	85%	-	3/8	100.0	0.0226	1.44
pH		6.6	#4	99.0	0.0129	0.00
Resistivity - ohm cm		22,905	#10	95.0		
Classification	Mechanical	Hydrometer	#40	49.0		
AASHO	A-1-b(o)	A-2-4(o)	#100	16.0		
UNIFIED	SW-SM-d	SW-SM-d	#200	6.4		

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 82B

Location: SE¼, SW¼, Sec. 26, T. 13 S. R. 7½ E			Mechanical Analysis		Hydrometer Analysis	
Depth: 8 - 40"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	89.62
Plasticity Index		N.P.	2 1/2	-	#40	61.68
Maximum Density - p.c.f.		81.0	2	-	#60	34.72
Optimum Moisture - %		27.0	1 1/2	-	#100	16.48
Specific Gravity, #10(-) only		2.85	1	-	#200	6.59
California Bearing Ratio	95%	16.6	3/4	-	Dia. MM 1/	
	90%	9.6	1/2	-	0.0350	4.10
	85%	-	3/8	100.0	0.0221	4.10
pH		6.8	#4	100.0	0.0128	2.24
Resistivity - ohm cm		22,905	#10	97.0	0.0089	0.00
Classification	Mechanical	Hydrometer	#40	42.0		
AASHO	A-1-b(o)	A-3(o)	#100	11.0		
UNIFIED	SP	SW-SM-d	#200	4.4		

Remarks: This material is a poorly graded sand with excellent drainage characteristics. It should have a fair to good value as a subgrade with little frost susceptibility. The soil has a fair workability as a construction material and has a poor erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 82C

Location: SE½,SW½,Sec.26,T.13 S,R.7½ E				Mechanical Analysis		Hydrometer Analysis
Depth: 40 - 54"				Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:			N.P.	3		#20	
Plasticity Index			N.P.	2 1/2	-	#40	
Maximum Density - p.c.f.			-	2	-	#60	
Optimum Moisture - %			-	1 1/2	-	#100	
Specific Gravity, #10(-) only			-	1	-	#200	
California Bearing Ratio		95%	-	3/4	100.0	Dia. MM 1/	
		90%	-	1/2	97.0		
		85%	-	3/8	95.0		
pH			-	#4	90.0		
Resistivity - ohm cm			-	#10	85.0		
Classification	Mechanical	Hydrometer		#40	58.0		
AASHO	A-2-4(o)			#100	28.0		
UNIFIED	SM-d			#200	19.6		

Remarks: This material is a poorly graded, silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 85A

Location: SW¼,SW¼,Sec.14,T.13 S,R.7 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 2 - 7"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3		#20	60.74
Plasticity Index		N.P.	2 1/2		#40	50.10
Maximum Density - p.c.f.		-	2		#60	39.33
Optimum Moisture - %		-	1 1/2		#100	25.92
Specific Gravity, #10(-) only		2.69	1		#200	12.96
California Bearing Ratio	95%	-	3/4	100.0	Dia. MM 1/	
	90%	-	1/2	99.7	0.0369	4.01
	85%	-	3/8	99.0	0.0232	3.17
pH		5.8	#4	91.0	0.0134	3.17
Resistivity - ohm cm		-	#10	73.0	0.0094	3.17
Classification	Mechanical	Hydrometer	#40	46.0	0.0066	2.33
AASHO	A-1-b(o)	A-2-4(o)	#100	21.0	0.0032	1.61
UNIFIED	SW-SM-d	SW-SM-d	#200	7.4	0.0013	1.49

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 85B

			Mechanical Analysis		Hydrometer Analysis	
Location: SW¼, SW¼, Sec. 14, T. 13 S, R. 7 E.			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 7 - 32"						
Liquid Limit:		N.P.	3		#20	14.34
Plasticity Index		N.P.	2 1/2		#40	6.96
Maximum Density - p.c.f.		65.4	2		#60	4.82
Optimum Moisture - %		26.0	1 1/2		#100	3.03
Specific Gravity, #10(-) only		2.78	1		#200	1.79
California Bearing Ratio	95%	11.2	3/4	100.0	Dia. MM 1/	
	90%	9.2	1/2	98.0	0.0364	1.58
	85%	-	3/8	94.0	0.0228	1.53
pH		6.8	#4	71.0	0.0130	1.14
Resistivity - ohm cm		-	#10	34.0	0.0091	0.00
Classification	Mechanical	Hydrometer	#40	6.0		
AASHO	A-1-a(o)	A-1-a(o)	#100	2.0		
UNIFIED	SP	SP	#200	0.9		

Remarks: This material is a poorly graded sand with excellent drainage characteristics. It should have a fair to good value as a subgrade with little frost susceptibility. The soil has a fair workability as a construction material and has a poor erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 92A

Location: NE¼,NW¼,Sec.4,T.22 S,R.6 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 0 - 17"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3		#20	67.85
Plasticity Index		N.P.	2 1/2		#40	30.90
Maximum Density - p.c.f.		-	2		#60	16.34
Optimum Moisture - %		-	1 1/2		#100	13.89
Specific Gravity, #10(-) only		2.55	1		#200	11.60
California Bearing Ratio	95%	-	3/4		Dia. MM 1/	
	90%	-	1/2	100.0	0.0379	9.65
	85%	-	3/8	99.8	0.0241	7.98
pH		6.0	#4	97.0	0.0139	4.51
Resistivity - ohm cm		22,905	#10	82.0	0.0097	4.37
Classification	Mechanical	Hydrometer	#40	20.0	0.0069	4.37
AASHO	A-1-b(o)	A-1-b(o)	#100	6.0	0.0034	2.70
UNIFIED	SP	SW-SM-d	#200	4.6	0.0014	1.86

Remarks: This material is a poorly graded sand with excellent drainage characteristics. It should have a fair to good value as a subgrade with little frost susceptibility. The soil has a fair workability as a construction material and has a poor erosion resistance.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 92B

			Mechanical Analysis		Hydrometer Analysis	
Location: NE¼, NW¼, Sec. 4, T. 22 S, R. 6 E.			Sieve Size	% Passing	Sieve Size	% Passing
Depth: 17 - 24"			3		#20	41.52
Liquid Limit:		N.P.	2 1/2		#40	34.19
Plasticity Index		N.P.	2	100.0	#60	28.62
Maximum Density - p.c.f.		-	1 1/2	94.0	#100	22.56
Optimum Moisture - %		-	1	75.0	#200	13.67
Specific Gravity, #10(-) only		2.64	3/4	73.0	Dia. MM 1/	
California Bearing Ratio	95%	-	1/2	68.0	0.0373	5.24
	90%	-	3/8	65.0	0.0240	2.31
	85%	-	#4	61.0	0.0137	1.74
pH		6.6	#10	49.0	0.0097	0.76
Resistivity - ohm cm		22,905	#40	26.0	0.0068	0.00
Classification	Mechanical	Hydrometer	#100	13.0		
AASHO	A-1-a(o)	A-1-b(o)	#200	6.6		
UNIFIED	SW-SM-d	SM-d				

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 93A

Location: SE¼, SE¼, Sec. 26, T. 22 S, R. 5½E			Mechanical Analysis		Hydrometer Analysis	
Depth: 18 - 40"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	38.68
Plasticity Index		N.P.	2 1/2	-	#40	31.73
Maximum Density - p.c.f.		-	2	100.0	#60	27.72
Optimum Moisture - %		-	1 1/2	94.0	#100	23.63
Specific Gravity, #10(-) only		2.73	1	84.0	#200	16.96
California Bearing Ratio	95%	-	3/4	79.0	Dia. MM 1/	
	90%	-	1/2	74.0	0.0356	6.81
	85%	-	3/8	70.0	0.0229	3.53
pH		6.0	#4	60.0	0.0133	1.12
Resistivity - ohm cm		22,905	#10	48.0	0.0093	0.00
Classification	Mechanical	Hydrometer	#40	27.0		
AASHO	A-1-a(o)	A-1-b(o)	#100	16.0		
UNIFIED	SW-SM-d	SM-d	#200	9.3		

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 93B

Location: SE¼, SE¼, Sec. 26, T. 22 S, R. 5½ E			Mechanical Analysis		Hydrometer Analysis	
Depth: 40 - 56"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	36.66
Plasticity Index		N.P.	2 1/2	-	#40	31.46
Maximum Density - p.c.f.		-	2	100.0	#60	27.91
Optimum Moisture - %		-	1 1/2	92.0	#100	24.18
Specific Gravity, #10(-) only		2.80	1	91.0	#200	18.28
California Bearing Ratio	95%	-	3/4	86.0	Dia. MM 1/	
	90%	-	1/2	78.0	0.0337	9.40
	85%	-	3/8	70.0	0.0217	6.88
pH		6.6	#4	57.0	0.0127	4.37
Resistivity - ohm cm		-	#10	43.0	0.0091	2.69
Classification	Mechanical	Hydrometer	#40	28.0	0.0064	1.85
AASHO	A-1-b(o)	A-1-b(o)	#100	21.0	0.0031	0.94
UNIFIED	GM-d	GM-d	#200	15.5	0.0013	0.87

Remarks: This material is a silty gravel with poor drainage characteristics and should make good subgrade. The soil has a medium frost action potential and a good erosion resistance when used as drainage structure.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 95A

Location: NW¼, NW¼, Sec. 20, T. 22 S, R. 6 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 26 - 35"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3	-	#20	34.70
Plasticity Index		N.P.	2 1/2	-	#40	26.52
Maximum Density - p.c.f.		-	2	-	#60	21.84
Optimum Moisture - %		-	1 1/2	100.0	#100	17.71
Specific Gravity, #10(-) only		2.75	1	77.0	#200	12.22
California Bearing Ratio	95%	-	3/4	74.0	Dia. MM 1/	
	90%	-	1/2	69.0	0.0358	6.03
	85%	-	3/8	64.0	0.0231	2.96
pH		6.8	#4	55.0	0.0132	1.49
Resistivity - ohm cm		22,905	#10	45.0	0.0092	0.98
Classification	Mechanical	Hydrometer	#40	25.0	0.0065	0.54
AASHO	A-1-a(o)	A-1-a(o)	#100	15.0	0.0032	0.54
UNIFIED	SW-SM-d	GM-d	#200	9.1		

Remarks: This material is a fair graded silty sand with fair drainage characteristics. It should have a good value as a subgrade except when subjected to frost action and should have good workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

REPORT OF LABORATORY TEST RESULTS

Landtype No. 95B

Location: NW¼, NW¼, Sec. 20, T. 22 S., R. 6 E			Mechanical Analysis		Hydrometer Analysis	
Depth: 35 - 48"			Sieve Size	% Passing	Sieve Size	% Passing
Liquid Limit:		N.P.	3		#20	45.56
Plasticity Index		N.P.	2 1/2		#40	38.25
Maximum Density - p.c.f.		-	2		#60	32.84
Optimum Moisture - %		-	1 1/2	100.0	#100	26.80
Specific Gravity, #10(-) only		2.78	1	91.0	#200	17.80
California Bearing Ratio	95%	-	3/4	84.0	Dia. MM 1/	
	90%	-	1/2	76.0	0.0351	6.99
	85%	-	3/8	72.0	0.0226	3.90
pH		6.8	#4	63.0	0.0130	2.26
Resistivity - ohm cm		22,905	#10	53.0	0.0092	1.23
Classification	Mechanical	Hydrometer	#40	34.0	0.0065	0.72
AASHO	A-1-b(o)	A-1-b(o)	#100	22.0	0.0031	1.15
UNIFIED	SM-d	SM-d	#200	12.8	0.0013	1.06

Remarks: This material is a poorly graded silty sand with fair drainage characteristics. It should have fair value as a subgrade except when subjected to frost and should exhibit fair workability as a construction material. The soil has poor erosion resistance and care should be taken in design of drainage structures.

1/ Particle size computed from hydrometer readings.

APPENDIX IV

SOIL CHEMICAL ANALYSIS

This appendix contains the Soil Chemical Analysis results from selected landtypes within the Soil Resource Inventory survey area.

All chemical analysis was performed by the Soil Testing Laboratory, Oregon State University, Corvallis, Oregon.

The laboratory test results presented in this appendix is intended to be used as a guide and indicator for planning purposes only. The test samples were collected at the landtype type locations.

FIGURE 6

CHEMICAL ANALYSIS OF SELECTED LANDTYPES [1/]

Extractable Cations

Landtype No.	pH	P (PPM)	K (PPM)	CA Meq/100g	MG Meq/100g	Total Bases (Meq/100g	% Total Nitrogen	Remarks
12 [2/]	6.1	4	461	3.1	1.5	5.78	0.10	
13	5.9	3	156	2.1	1.1	3.60	0.11	
14	5.9	2	332	4.2	1.2	6.25	0.11	
15	5.9	19	223	12.1	3.7	16.37	0.14	
16	6.2	2	371	8.1	3.5	12.54	0.08	
19	6.0	2	145	2.8	0.60	3.77	0.12	
21	6.1	53	627	25.1	6.7	33.40	0.14	
22	5.6	9	322	19.6	5.7	26.12	0.18	
23	5.7	6	341	3.6	0.98	5.45	0.12	
25	6.3	11	491	10.2	3.20	14.65	0.07	
31	6.5	9	273	16.5	2.7	19.90	0.04	
33	5.9	2	351	6.4	1.5	8.80	0.10	
35	5.6	2	185	14.1	3.2	17.70	0.10	
44	5.5	3	244	10.0	0.88	11.50	0.42	
55	5.4	3	213	5.4	0.34	6.28	0.12	
56 [3/]	5.9	2	253	4.5	0.39	5.53	0.05	Sample depth, 12-29 inches
61	6.2	4	78	2.6	0.60	3.40	0.07	
62	6.2	19	156	1.9	0.54	2.84	0.05	
63	6.2	2	156	1.2	0.39	1.99	0.19	
64	6.0	3	156	1.1	0.34	1.84	0.07	
66	6.0	2	166	2.3	0.54	3.26	0.09	
67	5.7	3	58	2.3	0.39	2.84	0.10	
69	6.1	8	234	15.8	4.8	21.20	0.05	
71	5.8	2	68	0.70	0.21	1.08	0.25	
74	5.9	2	145	0.70	0.39	1.46	0.22	
81	6.2	7	78	1.6	0.43	2.23	0.07	
82	6.1	16	40	0.70	0.21	1.01	0.04	
85-1	6.5	4	49	1.1	0.34	1.56	0.05	Sample depth 2-7 inches
85-2	6.6	2	58	0.70	0.34	1.19	0.01	Volcanic cinders; 7-32 inches
92-1	6.2	2	49	0.39	0.17	0.68	0.04	Pumice; 0-17 inches
92-2	6.3	2	40	0.18	0.17	0.45	0.05	Sample depth, 17-24 inches
93 [4/]	6.0	2	68	0.39	0.17	0.73	0.07	Sample depth; 18-40 inches
95 [4/]	6.3	2	78	0.39	0.17	0.76	0.02	Sample depth; 26-46 inches

1/ Soil analysis by Oregon State University Soil Testing Laboratory Corvallis, Oregon.
2/ Unless otherwise noted, samples consist of a composite sample taken from the surface 20 inches of soil material.
3/ Surface pumice layer, 0-17 inches, not sampled, see Landtype 92-1 for pumice analysis.
4/ Surface pumice layer not sampled; see Landtype 92-1 for pumice analysis.

FERTILIZERS AND FERTILIZATION 1/

The practice of using grass seedings and fertilizers for controlling soil erosion, stabilizing cut and fill slopes, and increasing timber production is becoming an increasingly important management tool. The following discussion will point out several considerations important to the successful and prudent use of fertilizers.

1. Use recent soil test results, taken in the soils to be treated, as the basis for determining the amount of plant nutrients to be applied.

2. Determine the pounds of plant nutrients to be applied per acre, and then select the fertilizer or fertilizers that will provide the desired plant nutrients. Pounds of plant nutrients and pounds of fertilizers <u>are not</u> the same thing.

3. When making fall fertilizer applications, do not apply more than 30 pounds of nitrogen per acre as more than this amount will probably not be utilized by the vegetation and will be leached from the rooting zone by the winter rains and spring snowmelt.

1/ The reader is encouraged to consult the following Handbooks and Publications for specific information concerning grass seeding and fertilization:

Forest Service Handbook, 2509.11, Land Treatment Measures Handbook

Oregon Interagency Guide for Conservation and Forage Seedings, U.S.D.A., Soil Conservation Service, Portland, Oregon, 1971

For example, if a fertilizer recommendation calls for 100# of nitrogen per acre, fall application, apply 30 pounds of nitrogen per acre in the fall and 70 pounds of nitrogen per acre the following spring. Phosphate and potash can be applied anytime, but preferably at seeding time.

4. The weight per unit volume and guaranteed plant nutrient analysis of various fertilizers vary considerably. By careful selection of the proper fertilizers, a significant savings in money, manpower, and time can be realized. For example, urea, which is 45% nitrogen, weighs 47 pounds per cubic foot. Ammonium sulfate, which is 21% nitrogen, weighs 65 pounds per cubic foot. In order to apply 100 pounds of nitrogen per acre, approximately 222 pounds of urea would be required or approximately 476 pounds of ammonium sulfate would be needed. When considering aerial application or large volumes of fertilizer, the weight and analysis of the fertilizer becomes very important.

APPENDIX V

DEFINITIONS OF MANAGEMENT INTERPRETATIONS [1/]

This Appendix contains the definitions for the management interpretations found in the MAP ATLAS under "Tables of Management Interpretations." These include Erosion and Hydrologic Interpretations, Recreation, Timber Management, and Engineering.

1/ Unless otherwise noted, the following definitions were developed for use in Soil Resource Inventories, R-6.

EROSION AND SOME HYDROLOGIC INTERPRETATIONS

Erosion and some hydrologic interpretations include erosion and water management interpretations. Interpretations for erosion include the two major kinds of erosion--surface and mass movement. Surface erosion pertains only to surface soil loss by runoff and overland flow. Mass movement pertains to all types of soil and bedrock movement which occurs below the soil surface such as landslips, slumps, slides, rockfall and land flow.

Natural Stability

This rating is based on the relative stability of the mapping units as they occur in the natural state. This includes any movement or loss other than surface erosion. Kind of movement includes slumps, slides, and all kinds of deep-seated failures. This rating applies throughout Region 6.

I. Very stable - No evidence of failure.

II. Stable - Occasional failures are observed.

III. Moderately stable - Several failures are observed.

IV. Unstable - Many failures are observed.

V. Very unstable - Entire area shows evidence of recent and past failures.

Nature of Mass Movement

This is an estimation of the kind and/or size of mass movement observed.

Expected Mass Movement as a Result of Man's Activities

This rating indicates the expected mass movement resulting from man's activities as compared to stability under natural conditions. Ratings are based on soil and bedrock characteristics, slopes, revegetation potential, and effects of timber removal, road construction and fire.

Unchanged - The expected mass movement is relatively unchanged from that of the natural state.

Increased - The expected mass movement is greater than that of the natural state.

Greatly increased - The expected mass movement is much greater than that of the natural state.

Surface Soil Erosion Potential

This rating is based on expected losses of surface soil when all vegetative cover, including litter, is removed. Evaluations of climate, slope gradient and length, soil characteristics, hydrologic characteristics of the soil and bedrock materials of each landtype unit are considered in making ratings.

Very slight - Practically no loss of surface soil materials is expected.

Slight - Little loss of soil materials is expected. Some minor sheet and rill erosion may occur.

Moderate - Some loss of surface soil materials can be expected. Rill erosion and some small gullies or sheet erosion may be occurring. Sheet erosion can be determined by some soil pedestals and observable accumulation of soil materials along the upslope edge of rocks and debris. At this level of erosion there is a possible fertility loss.

Severe - Considerable loss of surface soil materials can be expected. Rill erosion, numerous small gullies or evidence that considerable loss from sheet erosion may occur. Sheet erosion is indicated by frequent occurrence of soil pedestals and considerable accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a probable fertility loss.

Very severe - Large loss of surface soil material can be expected in the form of many large gullies and/or numerous small gullies or large loss from sheet erosion. Sheet erosion loss is exhibited by numerous examples of soil pedestals and extensive accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a fertility loss.

Subsoil Erosion Potential

This interpretation indicates the potential for subsoil erosion by water for each unit. It includes erosion which takes place after the surface soil has been removed (at least to 1-foot depth) such as in skid trails and firebreaks. Factors considered in making ratings are texture and structure of subsoil materials, slope, permeability, compaction, climate, and landform.

Low - Factors are such that little or no erosion may occur. Very little evidence of erosion.

Moderate - Considerable erosion occurring such as rills and small gullies. Factors indicate considerable erosion is likely to occur.

High - Factors indicate severe erosion may occur.

Suggestions for Controlling Subsoil Erosion

In this column suggestions are given, when applicable, for controlling erosion.

Water Yield Class

This interpretation is an indication of the rate and amount of water yield expected from each soil. It is based on factors such as soil characteristics, infiltration rates, permeability, slope, climate, vegetation, and drainage patterns.

Class I - These soils have a high water detention storage capacity and a low rate of runoff. Little water is yielded to peak flows until detention storage capacity is exceeded or unless the soils are initially saturated or frozen. They are important in sustaining high base flow due to a relatively large volume of water held in detention storage.

Class II - These soils have a moderate water detention storage capacity and a moderate rate of runoff. Water contributes to both peak flows and base flow.

Class III - These soils have a low water detention storage capacity and a high rate of runoff. The storage capacity is low and easily exceeded with most of the water contributing to peak flow. Little water is yielded to sustain base flow.

Bedrock Hydrologic Characteristics

This interpretation indicates the relative capacity of bedrock to store and transmit water. The rating is based on bedrock kind, texture, type and extent of fracturing, frequency of jointing, bedding characteristics, and degree of weathering.

Class I - This indicates that the bedrock has a relatively high capacity to store water. The water transmission rate is low unless the storage capacity is exceeded. Rocks in this class include sandstones because of their texture, fracture, and bedding characteristics, and basalts where water occurs in large tubes and other cavities or in the interflow zone between successive lava flows.

Class II - This indicates that the bedrock has a moderate capacity to store water. The rate of water transmission is moderate. Rocks in this class are generally hard to moderately hard, moderately fine textured, and moderately to highly fractured siltstone, mudstone, pyroclastics, argillite and schist.

Class III - This indicates that the bedrock has a relatively low capacity to store water. The rate of water transmission is rapid. Rocks generally in this class are fractured coarse crystalline (i.e., granite, gabbro and gneiss) and other hard-fractured rocks such as conglomerate.

Bedrock Hydrologic Characteristics (Cont.)

Class IV - This indicates that the bedrock has both low-storage capacity and low rate of water transmission. Rocks in this class are generally highly weathered, fine-textured, and lack open fracture channels.

Hydrologic Group

This interpretation is a grouping of soils into four classes, indicating the general infiltration and water movement ability of the soil and bedrock materials. This method of ratings has been developed by the Soil Conservation Service. The four groups are the standard SCS groupings and definitions.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively drained sands and/or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with high swelling potential, (2) soils with a high permanent water table, (3) soils with claypan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Silt and Clay Sediment Yield Potential

This interpretation indicates the potential for water sedimentation and pollution from silt and clay particles carried in suspension following timber harvest, road construction, or other activities. Factors considered in making ratings are soil texture and structure, drainage patterns, landform and climate.

Low - Sedimentation levels of silt and clay particles are not expected to be significant following management activities. Soils are generally moderately coarse-textured.

Sedimentation Yield Potential (Cont.)

Moderate - Sedimentation levels of silt and clay particles may be significantly increased following management activities with moderate loss of water quality and damage to fisheries. Soils are generally medium-textured.

High - Sedimentation levels of silt and clay particles are expected to be high following management activities. Streams become turbid and there is considerable loss of water quality and damage to fisheries. Soils are generally fine to moderately fine-textured.

Expected Sediment Size

This interpretation indicates the expected sediment size reaching the streams resulting from erosion of each unit. This interpretation is a statement of the two dominate separates expected (gravel, sand, silt or clay) from each soil unit. The ratings are presented in two columns. The first column indicates the separates expected from the surface soils, and the second indicates the separates expected from the subsoils.

RECREATION

Interpretations for recreation pertain primarily to recreation development. They are based on soil and bedrock properties, drainage, landform and vegetation. Factors such as aesthetics and accessibility are not considered when making these ratings. The following interpretations are some most generally needed for planning recreation developments.

Landtype Suitability for Recreation Area Development

This rating is based on soil and bedrock characteristics and topographic features of each unit as related to recreation development such as campground and picnic sites. Factors important to this interpretation are soil depth, texture, structure, permeability, drainage, topography, and susceptibility to flooding.

Unsuited - This rating indicates that soils and/or topography are of a nature which would prohibit recreation development without extensive modification.

Low - These soil units have major limitations to recreation development but limited development is feasible.

Moderate - This rating indicates that the soil unit is generally suitable for recreation development but has minor limitations.

High - These soils are particularly well suited for recreation development. Generally, they have no limitations.

Landtype Limitations for Recreation Development

This indicates the major soil limitations to recreation development.

Treatment to Increase Suitability

This indicates, when applicable, the treatment necessary to increase the suitability for recreation development.

Soil and Site Damage Susceptibility

This interpretation applies to recreational areas after development. Each soil that is suitable or can be made suitable for campground development is rated for its susceptibility to damage of soil and/or site by normal recreation use. Site includes vegetation as well as soil conditions. Factors used in determining ratings include erosion potential, soil compactibility, and vegetative growth potential.

Low - These soils resist compaction and have low erosion potential. The native vegetation is hardy and not readily destroyed. These soils will withstand and hold up well under continual use.

Soil and Site Damage Susceptibility (Cont.)

Moderate - These soils are not readily compacted or eroded and vegetative types are somewhat hardy. In general, these soils and site can sustain continual use but require some rehabilitation.

High - These soils are fragile and easily damaged and have vegetation that is not hardy, easily damaged and generally herbaceous. Under normal use, the vegetation will very likely be destroyed, the soil compacted and/or eroded to such a degree that periodic nonuse and major rehabilitation will be required.

Susceptibility to Dustiness

This interpretation pertains only to the soils suitable for recreation development, and applies primarily to unsurfaced roads within recreation areas.

Low - Factors indicate dust will not be a problem.

Moderate - Under normal conditions dust will not be a problem but under heavy use and droughty conditions dust very likely will be a problem.

High - Factors indicate dust will be a problem. Dust abatement measures are necessary under normal conditions and use.

Susceptibility to Muddiness

This interpretation pertains only to the soils suitable, or those that can be made suitable, for recreation development. This interpretation rates each soil as to its susceptibility to becoming muddy. The rating is limited to the surface soil under normal conditions. Factors include soil characteristics, climate and drainage.

Low - Muddiness is not likely to be a problem. Factors indicate soils are not susceptible to muddiness.

Moderate - Soils become muddy at times for short periods, occasionally causing problems. Road rock is usually necessary.

High - Soils are very likely to become muddy and stay muddy for long periods. Road rock is necessary. Campground closure may be necessary during wet periods.

Trail Suitability

This interpretation indicates the suitability of each soil for trails. Factors include soil and bedrock characteristics, drainage, climate, and slope.

Trail Suitability (Cont.)

Poor - These soils have properties which severely limit their use for trails. Extensive treatment measures are required.

Moderate - These soils have some limitations for trail development. Certain treatment measures may be required.

Well - These soils have no limitations for trail development.

Limitations for Trails

This indicates the limitations for trails.

Considerations for Trail Improvements and Protection

This indicates some treatment measures to be considered in improving suitability and protecting trails.

Suitability for Sewage Filter Field

This interpretation evaluates the soil as to its suitability as a sewage filter field. Ratings are based on soil depth, texture, permeability, drainage and slope. Only those soils suitable for recreation development are rated. Onsite investigation is recommended before design or installation of filter system.

Poor - These soils have properties which make them poorly suited as sewage filter fields. Sewage filter disposal in these soils would be ineffective and create major problems.

Moderate - These soils have properties which limit their use as sewage filter field. They require a large filter area for adequate drainage which limits the capacity of the campground.

Well - These soils are well suited to sewage filter use and offer only minor limitations, if any.

Soil Limitation to Sewage Filter Field Use

This indicates the major limitations to sewage filter field use.

TIMBER MANAGEMENT

Interpretations for Timber Management are of two types. One type includes some interpretations that directly affect timber management such as "Potential for Regeneration." The other type indicates the effect on soils and other resources from timber harvest activities.

Susceptibility to Brush Revegetation

This indicates the susceptibility of mapping units to revegetate naturally by brush following timber harvest. These ratings are based on soil characteristics, field observation, slope, aspect, climate and elevation.

Low - Indicates brush revegetation is insignificant.

Moderate - Indicates that some brush revegetation will occur.

High - Indicates brush revegetation is very dense.

Potentail for Regeneration

This interpretation indicates the potential for each landtype unit to regenerate at a minimum level of stocking as set by the Forest Service. Factors included in this interpretation are soil characteristics, climate, aspect, elevation, frost potential, brush competition, and tree species. Includes planted stock and natural regeneration.

Low - This rating indicates the potential for regeneration is low. Probability of success is very limited. Major regeneration problems can be expected and reseeding or replanting may be required throughout the area. Several years may elapse before an adequate stocking level is achieved.

Moderate - This rating indicates that some problems will be encountered in attaining a satisfactory stocking level. Usually regeneration is spotty and some replanting will be necessary.

High - This rating indicates that regeneration has a high probability of success. Few problems should be encountered in attaining good stocking levels.

Limitations to Regeneration

This indicates the major soil limitations to regeneration of planted stock and naturals.

Suggested Tree Planting Species

This column lists the tree species that the soil, climate, and topographic factors indicate may be best suited for planting.

Potential Soil and Water Impacts from Various Timber Harvest Methods

This interpretation indicates the susceptibility of soil and water resources to incur damage from various timber harvest methods. Each landtype is evaluated as to the potential impact from each of the following harvest methods: *Tractor logging, cable (no suspension), cable (partial suspension), cable (full suspension), and aerial logging. The evaluation of potential impact includes soil and water resource damages from timber removal, spur roads, landings and other activities that may be associated with the harvest method being evaluated. The evaluations are based on a full operating season. Damage is caused to soils by creating soil disturbance which may destroy soil structure, cause compaction and increase erosion. This may affect other resources through loss of production, lower water quality and yield, and loss of fisheries. Field observations indicate the most important factors to consider in making these ratings are wetness of soil, soil texture and structure, percentage of coarse fragments, slope, drainage, climate, and field observations.

Low - This rating indicates that the impacts to the soil and water resources are minor. Little or no soil damage is expected.

Moderate - This rating indicates that the impacts to the soil and water resources are moderate. Soil and water resources are expected to incur moderate damage.

High - This rating indicates that the impacts to the soil and water resources are major. Excessive damage to soil and water resources is likely to occur.

Type of Damage Expected During and Subsequent to Timber Harvest Operations

This indicates the type of soil and water resource damage expected on each soil from various harvest methods.

*See Glossary for definition of methods.

ENGINEERING

Interpretations for engineering include characteristics for roads, foundations, bedrock, and some miscellaneous interpretations. These are presented in two tables: One table, "Characteristics Pertinent to Roads and Airfields," is a standard engineering table for road construction based on the Unified Soil Classification System. The other table, "General Engineering Interpretation," gives other engineering interpretations which will be useful to engineers and other resource managers. These interpretations are explained and defined in this section. Generally, the following interpretations and ratings are based on the entire landtype unit including soil, bedrock and landform. Some interpretations are based only on the soil material or bedrock material. These are stated in the description for each interpretation. The interpretations pertaining to roads are based on standard Forest Service regulations and construction methods presently used.

Unified and AASHO Classification

Each soil is classified as to its Unified and AASHO Classification. Most soils will be classified into one class. Those soils with significant layers of different soil materials will have a classification for each layer designated. The classification will be made for some representative soils by laboratory testing. Those soils not tested will be classified by comparing their properties to those tested.

Suitability for Use as Topsoil Source

This rating evaluates each soil as to its suitability for use as topsoil. It does not specify any particular use of the topsoil. Ratings are based on soil characteristics.

Suited - Soil texture ranges from sandy loam to clay loam; gravel content is less than 35 percent and soil layer is at least 3 feet thick.

Unsuited - This rating indicates the soils do not satisfy the requirements specified under "Suited." However, soils rated "Unsuited" may still satisfy a particular requirement. See the "Table of Soil Characteristics" for soil texture, thickness and gravel content.

Suitability of Soil as Sand and/or Gravel Source

This interpretation indicates the suitability of each soil as a possible source of sand and/or gravel. It does not indicate the kind or quality of sand or gravel, or refer to any specific use of the sand and/or gravel.

Suitability of Soil as Sand and/or Gravel Source (Cont.)

Suited - This rating indicates that sand and/or gravel is present and the following conditions are satisfied: There is a layer present which is composed of 80 percent, by volume, of sand and/or gravel. This layer is at least 4 feet.

Unsuited - This rating indicates that sand and/or gravel is generally not present in amounts which satisfy the requirements under "Suited." However, soils rated "Unsuited" may still satisfy a particular requirement. See the Table of Soil Characteristics for soil depth and gravel content.

Suitability of Soil as a Possible Clay Source

This rating indicates the suitability of each soil as a possible source of clay. It does not indicate the kind or quality of clay or refer to any specific use of the clay.

Suited - This rating indicates that the soil is a possible source of clay. Soils with this rating have the following: Texture ranges from clay loam to clay. Gravel content is less than 35 percent. This layer is at least 2 feet thick.

Unsuited - Soils with this rating generally are not possible sources for clay.

Suitability of Bedrock for Road Rock

This interpretation indicates the general suitability of rock when used as road rock for base course or wearing surface. These ratings are based on rock hardness, density, and susceptibility to weathering and breakdown. Soils are not rated when depth to bedrock is greater than 12 feet. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data are required to accurately determine rock suitability.)

Unsuited - Rock is soft and breaks down rapidly under logging traffic.

Poor - Rock is only moderately hard and breaks down easily under logging traffic, usually in one or two years' time.

Fair - Rock is hard and dense but tends to break down under logging traffic after about two to four years' use.

Good - Rock is hard, dense and resists breakdown under logging traffic.

Limitations of Bedrock for Road Rock

This column indicates the major limitation of the bedrock for road rock use.

Estimate of Road Rock Thickness

This interpretation refers to estimated amount of road rock (base course and wearing surface) generally needed on heavy-vehicle, all-weather-use roads constructed on each soil. Factors involved in making this interpretation include field observations, texture and plasticity of soil, depth of bedrock, drainage, and kind of subgrade the road generally will have--common material or bedrock. Ratings are based on uncompacted fills and on the use of high quality rock. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data are required to accurately determine thickness needs.)

Very thin - Generally less than 10 inches.

Thin - Approximately 10 to 22 inches.

Thick - Approximately 22 to 36 inches.

Very thick - Generally over 36 inches.

Consideration for Road Location and Construction

This column indicates the major considerations for road location and construction through each soil. The rating evaluates the impact of road construction on other resources and/or road construction problems likely to be encountered.

Method of Excavation

This interpretation refers to excavation methods most commonly used and required for each soil. This includes soil, bedrock and cemented and/or compacted layers in the soil. Methods are blading, ripping, and/or blasting. (Cautionary note: These appraisals are subject to change as machinery capabilities change.)

Cutbank and Ditch Erosion Potential

This interpretation indicates the potential for subsoil erosion by running water on each soil. Subsoil refers to that material from approximately the 5-foot depth extending to bedrock. It includes erosion which takes place along road ditches and on cutslopes. Rating is of soil material only and does not apply when cutbank or ditch is in bedrock. Factors considered in making ratings are field observations, texture and structure of subsoil materials, permeability, compaction, and climate.

Low - Factors indicate that little or no subsoil erosion is likely to occur.

Moderate - Factors indicate that the subsoils have moderate erosion potential.

High - Factors indicate that the subsoils are likely to erode severely.

Susceptibility to Cutbank Sloughing and Raveling

This rating evaluates each unit for its susceptibility to sloughing or raveling after excavation. Ratings are based on cutbanks at least 10 feet high. Factors include field observations, soil and bedrock characteristics, backslope ratio, frost action, climate and potential for revegetation.

Low - Sloughing and/or raveling is a minor problem requiring occasional road maintenance.

Moderate - Sloughing and/or raveling causes some damage. Annual road maintenance is usually adequate.

High - Sloughing and raveling occur at a rate that often plugs culverts and fills inside ditches. Frequent road maintenance with heavy equipment such as front-end loader is required.

Estimated Cutslope Ratio

This interpretation estimates the cutslope ratio which generally will result in the most stable cutbank condition. Ratings made are for cutbanks at least 10 feet high and pertain both to soil and bedrock material. Ratings are based on soil and bedrock factors and on observations. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data is needed to determine the proper ratio.)

Steep - Cutbank ratio from vertical to ¼:1

Moderate - Cutbank ratio from about 1:1 to 1½:1

Flat - Cutbank ratio flatter than 1½:1

Probability of Cutbank Failures

This interpretation indicates the probability of failures in cutbanks following road construction or excavation for buildings. Failures are considered to be at least 10 cubic yards of material in volume. Ratings are based on cutbanks of at least 10 feet in height and refer to more than a 50-percent chance for failures. These ratings are the same as in the Mantle Stability Surveys.

I. Very stable - practically no probability of chance of cutbank failures.

II. Stable - probability of no more than 3 failures per mile of road cutbank.

III. Moderately stable - probability of 4 to 8 failures per mile of road cutbank.

IV. Unstable - probability of 9 to 15 failures per mile of road cutbank.

V. Very unstable - probability of more than 15 failures per mile of road cutbank.

Suggestions for Cutbank Stability Problems

This rating gives suggestions, when applicable, to increase stability of cutbanks or reduce damage from raveling and sloughing.

Failure Potential on Road Waste and Fills

This interpretation rates the soil units as to the susceptibility of failure occurring on fill and sidecast waste material and related damage to resources. Failures are defined as a loss or partial loss of road fill or sidecast material on the fill slope. Considered are initial and subsequent failures caused by construction, erosion and additional sidecast during maintenance. Failures result in damage to various resources. Stream sedimentation levels are increased, resulting in an adverse effect on both water quality and fisheries. Timber growth potential is affected as fill slope areas no longer contribute to production. Occasionally the failures do damage to the road itself. The ratings are based on current road construction practices and procedures and on type of soil materials, natural drainage of the site, landform, slope of the fill, and field observation.

Low - Failure on road waste and fills is sufficiently low to result in only minor damage to resource values.

Moderate - Failures on road waste and fills occur with sufficient frequency to cause moderate damage to resource values.

High - Failures on road waste and fills occur at a rate and magnitude sufficient to cause major damage to resource values.

Erosion Potential on Road Waste and Fills

This interpretation rates the soil units as to the susceptibility of erosion occurring on fill and sidecast waste material and related damage to resources. Erosion is a loss of surface soil from fill or sidecast.

This erosion contributes sedimentation to streams. Timber growth potential is affected as fill slope areas no longer contribute to production. The ratings are based on current road construction practices and procedures and on type of soil materials, natural drainage of the site, landform, slope of the fill, and field observation.

Low - Erosion on road waste and fills is sufficiently low to result in only minor damage to resource values.

Moderate - Erosion on road waste and fills occurs with sufficient magnitude to cause moderate damage to resource values.

High - Erosion on road waste and fills occurs at a magnitude sufficient to cause major damage to resource values.

Suitability of Road Waste & Fill Slopes to Seeding

This interpretation indicates the probable success of fill slope seeding. Factors considered in making ratings are soil characteristics, elevation, slope, climate, snowpack, and frost hazard. Ratings are based on current methods and practices of seeding, grass species, fertilizer application and time of seeding.

Poor - Probability of success is low. Seeding generally is not successful and requires three or more reseedings and special treatments.

Fair - Success is likely on about 50 percent of area treated. Requires one or two followup treatments. Seeding usually becomes well established within two years. Little followup seeding necessary.

Good - Probability of high success. Seeding usually becomes well established within two years. Little followup seeding is necessary.

Limitations to Road Waste and Fill Slope Seeding

This indicates the major limitations to success of fill slope seeding.

Suggestions for Road Waste and Fill Slope Seeding

This indicates special treatment to be given, when applicable, to increase the chance of success of fill slope seeding. A statement indicates the necessary requirements other than normal fill slope seeding practices carried on by the Forest.

Suitability of Cutbanks to Seeding

This interpretation indicates the probable success of cutbank seeding. Factors considered in making ratings are soil characteristics, elevation, slope, climate, snowpack, and frost hazard. Ratings are based on current methods and practices of seeding, grass species, fertilizer application and time of seeding.

Poor - Probability of success is low. Seeding generally is not successful and requires three or more reseedings and special treatments.

Fair - Success is likely on about 50 percent of area treated. Requires one or two followup treatments. Seeding is usually spotty; some areas become easily established, while others fail completely.

Good - Probability of high success. Seeding usually becomes well established within two years. Little followup seeding necessary.

Limitations to Cutbank Seeding

This indicates the major limitations to success of cutbank seeding.

Suggestions for Cutbank Seeding

This indicates special treatment to be given, when applicable, to increase the chance of success of cutbank seeding.

APPENDIX VI

TERMS AND DEFINITIONS OF MAPPING UNIT CRITERIA 1/

This appendix contains the terms and definitions used in soil resource inventories. These terms and definitions are used in compiling information for the TABLE OF SOIL CHARACTERISTICS OF MODAL SITES; TABLE OF SOME MAPPING UNIT CHARACTERISTICS, FEATURES, AND QUALITIES; TABLE OF BEDROCK CHARACTERISTICS OF MAPPING UNITS; and the MAPPING UNIT DESCRIPTIONS.

1/ Unless otherwise noted, the following definitions were developed for use in Soil Resource Inventories, R-6.

SOIL CHARACTERISTICS

Soil - Any and all loose, unconsolidated, weathered material on the earth's surface resting on solid, consolidated, unweathered bedrock, regardless of origin, mode of formation, or type of weathering or deposition. Generally includes any material that may be manipulated by hand tools or heavy equipment without the need of blasting except soft, unweathered bedrock. In soil horizon designation, soil materials included "A", "B", and "C" horizons.

Depth of Soil to Bedrock - Distance from soil surface to consolidated, unweathered bedrock. Depth is in feet or inches.

Shallow - less than 3 feet.

Moderately deep - 3 to 6 feet.

Deep - 6 to 12 feet.

Very deep - greater than 12 feet.

Depth to Restrictive Layer in the Soil - Distance from soil surface to a layer in the soil that is highly restrictive to drainage, water transmission or root growth. Usually this is a discontinuity or stratification layer, but it may be bedrock. If it is bedrock, depth must be the same as recorded under depth to bedrock. A restrictive layer is generally not a genetic soil horizon, except in old soils that have developed claypan, hardpan, or cemented horizons. Depth is in feet.

Litter - Total depth in inches of decomposed and undecomposed organic matter.

Soil Layer - Each soil layer is a homogeneous layer of soil material. Soil layers are described when soil characteristics change significantly and have definite effects on management. Each layer may result from stratification or soil formation processes.

Soil Layer Thickness - Thickness of each soil layer in inches.

Soil Layer Thickness Classes - Thickness is in feet or inches.

Thin - less than 3 feet.

Moderately thick - 3 to 6 feet.

Thick - 6 to 10 feet.

Very thick - greater than 10 feet.

Color - Stated in narrative Munsel notations for each soil layer. Colors are taken of moist crushed soil. Mottling is noted, if present, especially in subsoil layers.

Texture - Relative proportions of sand (2.0mm.-.05mm.), silt (.05mm.-.002mm.), and clay (less than .002mm.). Standard USDA textural classes are used for each soil layer.

Textural Classes*- These classes apply when general textural terms are used for the profile sketch in the mapping unit descriptions.

Coarse-textured soils - Sands, loamy sands.

Moderately coarse-textured soils - Sandy loam, fine sandy loam.

Medium-textured soils - Very fine sandy loam, loam, silt loam, silt.

Moderately fine-textured soils - Clay loam, sandy clay loam, silty clay loam.

Fine-textured soils - Sandy clay, silty clay, clay.

Rock Fragment Quantity, Size, and Shape*- Percent by volume occupied by consolidated fragments larger than sand size (larger 2mm.).

Size Classes - gravel, 2mm. - 3 inches; cobbles, 3 inches to 10 inches; stones, greater than 10 inches.

Shape Classes - round, thin, flat, subangular, subround, angular, blocky, etc.

Rock Fragment Classes - Used as an adjective to textural classes. Includes gravel, cobble and stone sizes.

0 - 35 percent - not noted.
35 - 50 percent - gravelly, cobbly or stony.
50 - 80 percent - very gravelly, very cobbly or very stony.
80 percent + - extremely gravelly, extremely cobbly or extremely stony.

Soil Structure*- Includes grade, size and type of structure for each soil layer. If no structure exists, then the soil is massive or single-grained. Concretions or shot are recorded, if present. Applies to aggregate structural units (aggregates and peds).

* Standard USDA Handbook 18 Definitions.

Grade - Degree of aggregation and expression of the differential between cohesion within aggregates and adhesion between aggregates.

Weak - Indistinct peds, barely observable in place.

Moderate - Distinct peds, moderately durable and evident.

Strong - Distinct peds in place, durable.

Size - Refers to size of aggregates according to five size classes and type of structure.

	Platy	Prismatic	Columnar	(Angular) Blocky [1]	Subangular blocky [2]	Granular	Crumb
Very fine or very thin.	Very thin platy; <1 mm.	Very fine prismatic; <10 mm.	Very fine columnar; <10 mm.	Very fine angular blocky; <5 mm.	Very fine subangular blocky; <5 mm.	Very fine granular; <1 mm.	Very fine crumb; <1 mm.
Fine or thin	Thin platy; 1 to 2 mm.	Fine prismatic; 10 to 20 mm.	Fine columnar; 10 to 20 mm.	Fine angular blocky; 5 to 10 mm.	Fine subangular blocky; 5 to 10 mm.	Fine granular; 1 to 2 mm.	Fine crumb; 1 to 2 mm.
Medium	Medium platy; 2 to 5 mm.	Medium prismatic; 20 to 50 mm.	Medium columnar; 20 to 50 mm.	Medium angular blocky; 10 to 20 mm.	Medium subangular blocky; 10 to 20 mm.	Medium granular; 2 to 5 mm.	Medium crumb; 2 to 5 mm.
Coarse or thick.	Thick platy; 5 to 10 mm.	Coarse prismatic; 50 to 100 mm.	Coarse columnar; 50 to 100 mm.	Coarse angular blocky; 20 to 50 mm.	Coarse subangular blocky; 20 to 50 mm.	Coarse granular; 5 to 10 mm.	
Very coarse or very thick.	Very thick platy; >10 mm.	Very coarse prismatic; >100 mm.	Very coarse columnar; >100 mm.	Very coarse angular blocky; >50 mm.	Very coarse subangular blocky; >50 mm.	Very coarse granular; >10 mm.	

Type - Refers to relative shape of individual aggregates. There are four primary basic shapes.

Platy - Soils particles arranged around a plane, generally horizontal.

Prism-like - Soil particles arranged around a vertical line and bounded by relatively flat surface (Prismatic, Columnar).

Block-like - Soil particles arranged around a point and bounded by flat or rounded surfaces (Angular Blocky, Subangular Blocky).

Spheroidal - Soil particles arranged around a point and bounded by curved or very irregular surface (granular, crumb).

Structureless - No observable aggregation or no definite orderly arrangement of natural lines of weakness.

Massive - The soil material is coherent.

Single Grain - The soil material is incoherent.

Cementation*- Includes degree of cementation and the agent of cementation (Ca, Fe, Al, Si). Cementation is generally caused by a chemical process.

Degree of Cementation

Weak - Soil aggregates can be easily broken by hand, and usually nonrestrictive to water and roots. Example: fragipan.

Strong - Soil aggregates are difficult to break by hand or hand tools and resist movement and penetration of water and roots. Water may be perched or ponded for short periods. Aggregates can be penetrated by hand tools.

Indurated - Soil aggregates are insoluble in water and cannot be broken by hand tools. Aggregates are totally restrictive to water and roots, and usually require ripping or blasting.

Compaction - Relative increase in bulk density which is caused by natural pedogenic processes.

Degree of Compaction

Weak - Soil aggregates are easily broken by hand and are usually nonrestrictive to water and roots.

Moderate - Soil aggregates are difficult to break by hand and resist movement and penetration of water and roots. Water may be perched or ponded for short periods of time.

Strong - Soil aggregates cannot be broken by hand. The soil exhibits nearly total restriction to water and root penetration, and usually requires ripping or blasting.

Permeability - Water or air movement in and through the soil material. The classes are based on soil texture, rock fragment content, porosity and bulk density.

Class:

Very slow - Generally fine-textured soils - clay. Less than .05 inch/hr.

Slow - Generally moderately fine-textured soils - clay loams and silty clay loams. .05 inch/hr. to 1 inch/hr.

Moderate - Generally medium-textured soils - loams, silt loams. 1 inch/hr. to 5 inches/hr.

Rapid - Generally moderately coarse-textured soils, sandy loams, gravelly loams. 5 inches/hr. to 20 inches/hr.

Very rapid - Very porous soils. Generally coarse-textured soils - sands and gravels. Greater than 20 inches/hr.

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* Standard USDA Handbook 18 Definitions.

Consistence*- degree of cohesion and adhesion as indicated by the resistance of the soil aggregate to deformation or rupture under various moisture conditions.

Dry:

Loose - noncoherent.

Soft - easily crushes to powder or single grain.

Slightly hard - easily broken between thumb and forefinger.

Hard - can be broken in the hands without difficulty but difficult to break between thumb and forefinger.

Very hard - can be broken in hands without difficulty.

Extremely hard - cannot be broken in hands.

Moist:

Loose - noncoherent.

Very friable - crushes under gentle pressure.

Friable- crushes easily under gentle to moderate pressure between thumb and forefinger.

Firm - crushes under moderate pressure between thumb and forefinger.

Very firm - crushes under strong pressure, barely crushable between thumb and forefinger.

Extremely firm - crushes under very strong pressure, cannot be crushed between thumb and forefinger.

Wet:

Stickiness is measured by pressing wet soil between fingers.

Nonsticky - practically no adherence when pressure is released.

Slightly sticky - after pressure, soil adheres to both thumb and finger but comes off one rather cleanly. Does not stretch appreciably.

Sticky - after pressure, soil adheres to both thumb and finger and tends to stretch somewhat before pulling apart from either digit.

Very sticky - after pressure, soil adheres strongly to both digits and is markedly stretched when they are separated.

* Standard USDA Handbook 18 Definitions.

Plasticity is measured by rolling wet soil and observing wire.

Nonplastic - no wire is formable.

Slightly plastic - wire forms, but soil mass easily deformed.

Plastic - wire forms, moderate pressure required to deform soil mass.

Very plastic - wire forms, much pressure required to deform soil mass.

Soil pH - intensity of soil acidity or alkalinity expressed on a scale from 1 to 14:

	pH		pH
Extremely acid	- below 4.5	Neutral	6.5 - 7.3
Strongly acid	- 4.6 - 5.5	Slightly alkaline	7.4 - 8.4
Slightly acid	- 5.6 - 6.4	Strongly alkaline	8.5 - 9.0
		Very strongly alkaline	above 9.0

Classification - estimated taxonomic classification at family level.

LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

Infiltration Rate - Rate of entry of water into soil surface. The rate is dependent upon the type of surface soil texture, rock fragment content, structure, porosity, bulk density and organic matter content.

Infiltration Rate Classes:

Slow - Water stands on surface for long periods. Soils are fine-textured, poorly aggregated and puddle easily.

Moderate - Water enters soil at commensurated rates of normal rainfall or water application. Water may pond for short periods (a few days) following very intensive rainfall. Soils are medium-textured and well aggregated.

Rapid - Water rarely ponds, enters soil surface very rapidly. Soils are coarse-textured, porous, loose and usually single-grained.

Drainage Class 2/ - The rapidity and extent of removal of water from the soil. Based on soil permeability, infiltration, internal drainage and topographic position.

Poorly drained - Water table at or near the surface a considerable part of the time. Soils of this class usually occupy level or depressed sites and are frequently ponded. Water is removed so slowly that soil remains wet almost all the time.

Somewhat poorly drained - Water removed so slowly that the soil remains wet for significant periods, but not all the time.

Moderately well drained - Soil remains wet for a period somewhat longer (up to one month) than the wet season; may be due in part to a slowly permeable layer, high water table or lateral seepage.

Well drained - Water is removed from soil readily and these soils are saturated only during the wet season for short periods.

Excessively drained - Water is removed from soil rapidly and these soils are rarely ever saturated. Commonly, these soils are coarse-textured or shallow, stony and/or occur on steep slopes.

Major Drainage Intensity and Pattern - Number of drainage miles per square mile and dominant drainage pattern.

Intensity Classes:

Few - 0 to 1 drainage mile per square mile.

Common - 1 to 3 drainage miles per square mile.

Many - 3 to 5 drainage miles per square mile.

Abundant - Greater than 5 drainage miles per square mile.

2/ Very poorly drained and somewhat excessively drained classes are not used.

Patterns (State drainage pattern):

Productivity - Combined evaluation of measured and observed production of timber and forage types. Site classes are to be used for timber types, and range condition ratings for range types.

Timber Site Classes 3/ - Class limits correspond to height (site index) of Douglas-fir at 100 years.

Class I - greater than 185 S.I.

Class II - 185 S.I. to 155 S.I.

Class III - 155 S.I. to 125 S.I.

Class IV - 125 S.I. to 95 S.I.

Class V - less than 95 S.I.

Fertility - Estimated inherent soil fertility and availability of plant nutrients. This rating is derived by correlating measured productivity with soil factors such as texture, pH, color and organic matter content.

High - These soils generally have medium to fine texture, dark surface colors; are slightly acid to slightly alkaline and have abundant incorporated organic matter. Nutrient quantities are adequate and readily available.

Moderate - These soils generally have one or more soil factors that limit nutrient quantity and/or availability.

Low - These soils generally have several factors that are limiting. They may be coarse-textured, strongly acid or strongly alkaline, and lacking in sufficient organic matter. Nutrient quantity and/or availability is seriously limiting.

Percent Vegetative Cover - Evaluations of total vegetative cover and the cover of three distinct levels of vegetation above the soil surface. Overstory consists of the timber stand canopy. Understory consists of woody shrubs, and timber regeneration. Ground cover consists of ferns, grasses, sedges, and mosses.

Total Ground Cover - Estimated percent of total vegetative cover with overstory, understory and ground cover combined. Maximum of 100 percent.

Vegetative Cover by Each Level - Estimated percent vegetative cover according to species composition, with overstory, understory, and ground cover estimated separately. Maximum of 100 percent for each level.

3/ McArdle, Technical Bulletin 201. All other Timber Site Classes are from R-6 Timber Inventory Procedures Handbook.

Root Distribution*- Includes root size, abundance and depth to zone of rooting. Note maximum depth of roots and zone of maximum concentration.

Size:

Very fine - 0.075mm

Fine - 1 to 2mm

Medium - 2 to 5mm

Coarse - over 5mm

Abundance:

Very few - less than 1/unit 4/

Few - 1 to 3/unit

Plentiful - 4 to 14/unit

Abundant - more than 14

Depth:

Recorded depth in inches of zone of rooting. Distance is measured from soil surface to depth of majority of roots.

Landform - refers to the shape and configuration of a specific, identifiable part of the landscape common to the mapping unit.

Slope - Range of slope of landtype.

Aspect - Direction of slope exposure.

Elevation - Altitude above mean sea level expressed in feet.

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* Standard USDA Handbook 18 Definitions.

4/Unit is a square inch for fine to very fine; a square yard for medium and coarse roots.

BEDROCK CHARACTERISTICS

These terms are found in the Table of Bedrock Characteristics of Mapping Units.

Bedrock - Consolidated, competent rock which upon weathering produces loose or unconsolidated soil material. In terminology of soil horizon designation, bedrock is designated at the "R" layer. Bedrock material usually requires ripping and/or blasting. Includes soft materials that are unweathered such as some sedimentary rock which can be bladed. (Example: Sandstone.)

Composition - Bedrock components and percentage. (Example: Sandstone (20), Conglomerates (70), Mudstone (10).

Color - Color is in narrative terms for fresh, unweathered surfaces.

Hardness - Relative rating based on ease of breaking rock with geology hammer:

Hard - Rock cannot be broken or only with great difficulty.

Moderately hard - Rock can readily be broken with hammer but not by hand.

Soft - Rock can be broken by hand.

Degree of Fracturing - Based on the number or frequency of fractures and joints in a rock unit:

Highly fractured - Entire rock unit is completely dissected by fractures and joints less than 1 foot apart.

Moderately fractured - Fractures divide rock unit into units or blocks generally from 1 to 5 feet apart.

Slightly fractured - Only occasional fractures noted.

Massive - No fractures or very few fractures noted.

Fracture System - Pattern which the rock fractures follow. Example: horizontal, platy, vertical, blocky, random, etc.

Fracture Surface - Indicates the characteristics of the fracture surface and void space within fractures.

Regular - Smooth, distinct, sharp, clean-fractured surfaces.

Irregular - Rough, irregular, fragmented fracture surfaces.

Bedrock (Cont.)

Competency - Relative inherent strength of rock as it occurs on the landscape, based on degree of weathering, fracturing, hardness, stability and failures observed:

Competent - No failures within rock unit observed. Rocks of unit are stable and have strong resistance to mass movement.

Moderately competent - Some failures are noted. Rocks of the unit are moderately stable and have some resistance to mass movement.

Incompetent - Failures are common to rock unit. Rocks of the unit are soft, deeply weathered and have high potential for mass movement.

APPENDIX VII

GLOSSARY

Aerial Logging - Logging systems using helicopters or balloons where logs are lifted vertically and yarded free and clear of the ground.

Agglomerate - A pyroclastic rock containing a predominance of rounded or subangular fragments.

Alluvium - Stream deposits of gravelly sand, silt, or clay.

Andesite - A dark gray to black, dense, fine-grained extrusive igneous rock. Very similar to basalt.

Andesitic Breccia - A fractured andesite with inclusions of angular fragments of other previously formed rocks.

Ash - Sand-size volcanic ejecta as used in this report.

Asymmetrical - Unsymmetrical; without proper proportion of parts.

Basalt - A dark gray to black, dense, fine-grained extrusive igneous rock. Very similar to andesite.

Basaltic Breccia - Rock, composed of angular fragments in a finer groundmass, having a composition similar to, or the same as, basalt.

Breccia - Rock composed of angular fragments in a finer groundmass.

Base Flow - Sustained or fair weather runoff. It is composed of ground-water runoff and delayed sub-surface runoff.

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

Block Glide - A deep-seated, slow-moving failure, marked by lateral separation with but little vertical displacement. Generally occurs in plastic materials.

Cable (No Suspension) - Yarding method where logs are dragged on the ground to a landing.

Cable (Partial Suspension) Yarding method where one end of the log is suspended above the ground surface during the yarding operation.

Cable (Full Suspension) - Logs are yarded free and clear of the ground surface to a landing.

Cinders - Primarily uncemented, glassy, and vesicular volcanic ejecta ranging chiefly from 4 to 3 mm. in diameter.

Cirque Basin - A half-amphitheater formed by alpine glaciation with three steep sides. Usually found at upper ends of valleys and along ridges.

Clastic Sediments - Sediments transported into their place of deposition; i.e., sandstone, siltstone.

Clay - A soil separate less than .002 mm. 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.

Colluvium - Soil material or rock fragments moved downslope by gravitational force in the form of soil creep, slides, and local wash.

Compaction - The packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

Complex - An association in which two soil units or a soil unit and a miscellaneous land type are so intricately mixed that it is not practical to show them separately at the scale of mapping used.

Conglomerate - A cemented clastic rock containing rounded fragments in a finer groundmass.

Consequent Drainage - Drainage that is a direct consequence of the original slope of the surface on which it developed.

Constructional Slopes - Slopes that owe their origin and present surface features to the distribution of lava sheets or other volcanic ejecta.

Critical Soil - The term "critical soil" is frequently used by laymen, but it is a meaningless term unless it is related to a specific function. Many soils may be critical for one reason or another, but different soils may not be critical for the same reasons. For example, a deep, wet, plastic and unstable soil will be critical in relation to road location and stability. This soil is not critical in relation to regeneration and drouthiness problems. Another soil may be very shallow over hard bedrock. This soil is not critical from the standpoint of road stability, but may be critical as to regeneration problems resulting from drouthiness and low fertility. It may also be critical in relation to surface erosion. From these two samples it becomes obvious that the term "critical soil" must be defined by the user in relation to its intended purpose.

Debris Slide - A rapidly moving slide composed of soil, bedrock, or both.

Devitrification - The process by which glassy rocks break up into definite minerals.

Dike - An intrusive igneous rock that cuts through pre-existing rock structure or massive rocks.

Erosion - The wearing away of the land surface by running water, wind, ice or gravitational creep. Accelerated erosion may result from the activities of man or animals.

Extrusive Bedrock - This applies to those igneous rocks derived from volcanic lavas that cooled on the surface of the earth. This lava rapidly cools and forms fine-textured rocks such as basalt and andesite.

Geomorphology - The study of landforms as they relate to geologic composition and history.

Glacial Drift - The debris deposited by glaciers or by streams directly associated with them.

Glacial Soils - Soils derived from materials transported or influenced by glaciers.

Glaciated Valley - U-shaped valley formerly occupied by a glacier.

Hummocky - Hilly, uneven landscape resulting from deep-seated soil movement usually of a rotational nature.

Hydrothermal Alteration - Changes in rocks brought about by the addition or removal of materials through the medium of hydrothermal fluids.

Inclusion - Soil type found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

Intrusive Bedrock - This applied to those rocks derived from magmas that have been injected into older rocks at depth without reaching the surface. These magmas are slow-cooling and form coarse-textured rocks, such as granite.

Ishohyetal Map - A map with lines along which all points receive the same amount of precipitation.

Landform - Structural configuration of the topography as a result of past and present geological activity.

Lapilli-Tuff - A pyroclastic deposit made up of "popcorn"-sized material in a tuff matrix.

Lithology - The study of rocks based on examination of samples.

Mapping Unit - Any delineated area shown on a soil map that is identified by a number. A mapping unit may be a soil unit, a miscellaneous landtype or a complex.

Massive - Soil structure or bedrock condition in which there is no observable aggregation or no definite orderly arrangement of natural lines of weakness.

Mass Movement - All movement of soil and bedrock materials occurring below the soil surface such as landslips, landflows, rock slides, slumps, etc.

Mass Wasting - Wearing away of the landscape through the process of mass movement. Geologic erosion.

Miscellaneous Landtypes - A mapping unit for areas of land that have little or no natural soil or have properties that are too variable and unpredictable for classification.

Outwash - Glacial material swept out, sorted and deposited by water that originated from the melting of glacial ice.

Paternoster Lakes - A chain of small glacial lakes connected by drainage.

Peak Flow (Peak Runoff) - The greatest water discharge for any single runoff period.

Physiographic Divisions - Broad groupings based on the physical features of the landscape.

Plastic Soil - A soil capable of being molded or deformed continously and permanently, by relatively moderate pressure, into various shapes.

Porphyritic - An igneous rock textural term in which larger crystals are set in a finer groundmass.

Propylitization - The introduction of, or replacement by, an assemblage of secondary minerals. Most characteristic of hydrothermally altered andesitic rocks.

Pumice - An excessively cellular, light-colored, volcanic ejecta.

Puncheons - Piling or split logs laid horizonally across wet areas.

Pyroclastic - A general term applied to rocks formed from volcanic material that has been explosively or aerially ejected from a volcanic vent.

Residuum - Soil material formed by rock weathering in place.

Rotational Failure - Mass movement in which the zone of failure, in cross section, scribes an arc.

Runoff - That part of the precipitation which appears in surface streams of either perennial or intermittent form.

Sand - A soil separate between .05 and 2.0 millimeters in diameter.

Sandstone - A rock composed primarily of cemented sand-size grains.

Saprolite - Thoroughly decomposed residual rock often high in clay content.

Sedimentary Rock - Rock formed by deposition of soil and rock particles by water, ice or wind that later solidifies through cementation, ionic exchange or compression.

Sheet Erosion - Uniform removal of surface soil by water flowing overland or by wind.

Shield Volcano - A broad, gently sloping volcanic cone of domical shape made up of overlapping and inter-fingering lava flows.

Sill - An intrusive igneous rock that lies parallel to bedding in pre-existing rock.

Silt - A soil separate consisting of particles between 0.002 and 0.05 millimeters in diameter.

Siltstone - A sedimentary rock consisting primarily of silt-size particles.

Slump - A deep-seated, slow-moving rotational failure occurring in plastic materials resulting in vertical and lateral displacement.

Soil - Any and all loose, incoherent, unconsolidated weathered material on the earth's surface resting on solid, consolidated, unweathered bedrock, no matter how formed, or origin, or method of weathering or deposition. Generally includes any material that may be moved or broken by hand tools or heavy equipment without the need of blasting except soft, unweathered bedrock. In soil horizon designation, soil materials included "A", "B", and "C" horizons.

Soil Creep - Slow mass movement of soil material downslope primarily under the influence of gravity, but facilitated by saturation with water and/or by alternating freezing and thawing.

Soil Unit - Taxonomic description of a portion of the landscape sufficiently uniform in soil, bedrock and landform that it can be clearly defined and easily recognized wherever it occurs.

Spot Symbols - Symbols used on soil maps to represent a landscape factor too small to delineate.

Surface Slips - Rapid movement downslope of the surface few feet of soil on steep slopes.

Till - Glacial materials deposited directly by ice with little or no transportation by water. It is generally an unconsolidated, unstratified compact mixture of clay, silt, sand, gravel and boulders.

Toeslope - That portion of a slope that is transitional between the valley floor and the upper slope.

Topography - The relief features or surface configuration of an area.

Tractor Logging - Timber harvest method whereby logs are dragged by a tractor to a loading site.

Translational Failures - Downslope displacement of soil-rock material on a surface which is roughly parallel to the general ground surface.

U-shaped Valley - Descriptive phrase of the cross profile of a valley which has been carved out by glacial movement.

Volcanic Ejecta - Any and all material forcibly blown out of volcanic cones, fissures, and vents.

V-shaped Valley - A descriptive phrase of the cross profile of a valley which has been cut by stream action.

Welded Tuff - A tuff that has been indurated by the combined action of the heat retained by the particles and the enveloping hot gases.