



United States
Department of
Agriculture

In Cooperation with
the Montana Agricultural
Experiment Station

Forest Service
and
Natural
Resources
Conservation
Service

Soil Survey of Flathead National Forest Area, Montana



How to Use This Soil Survey

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

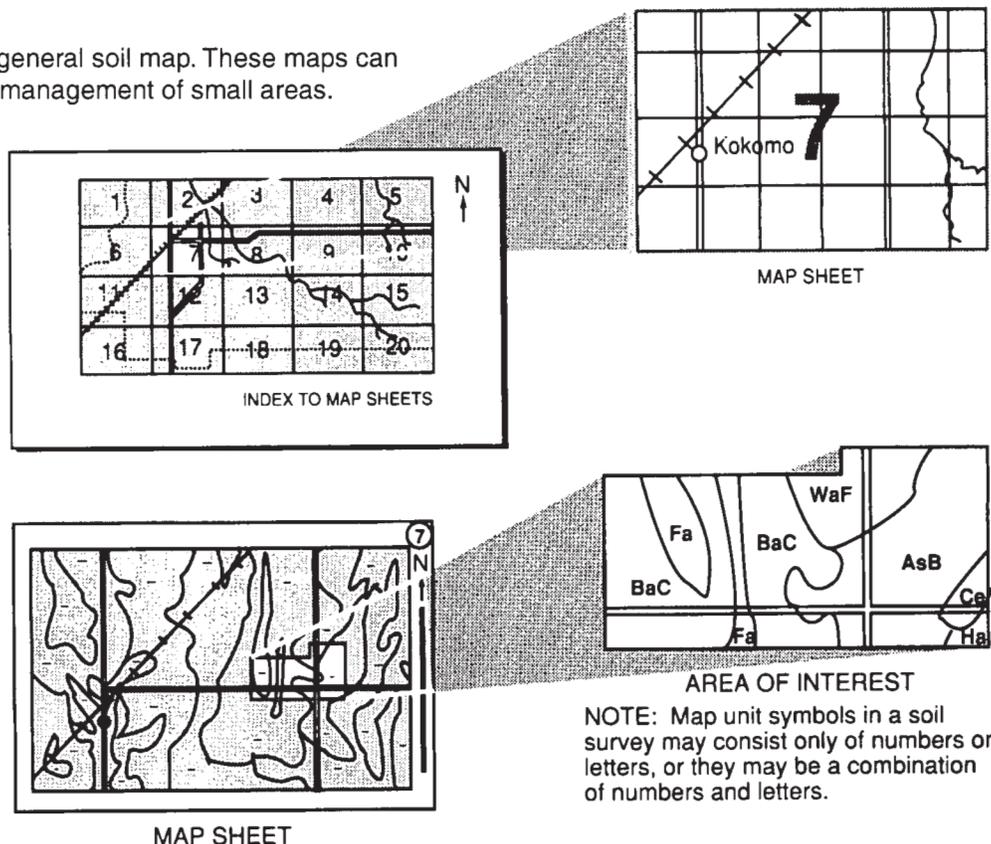
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

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

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

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



This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, state agencies, including the Agricultural Experiment Stations, and local agencies. The field work and technical quality control for this survey were conducted by the Forest Service. The correlation of the soils was conducted by the Soil Conservation Service in consultation with the Forest Service. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. Montana Department of State Lands provided assistance in mapping state lands. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Field work for this soil survey was performed in the period 1971-1981. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made by the United States Department of Agriculture, Forest Service and Soil Conservation Service in cooperation with Montana Agricultural Experiment Station.

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

Cover: A view of the Hungry Horse Reservoir. Great Northern Mountain is in the background.

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Preface

This soil survey contains information that can be used in land-planning programs in the survey area. The landforms, natural vegetation, and bedrock were studied to a greater extent than usual in soil surveys in order to define and interpret map units. Surveys such as this one have been referred to in Forest Service publications as “land system inventories” or “integrated inventories”. The map units have been called “landtypes”.

This survey contains information that generally is not included in soil surveys. Examples are ratings of sediment delivery efficiency and limitations affecting road construction and maintenance. The survey is designed primarily for use by Forest Service personnel managing Flathead National Forest. Others who are interested in management of Flathead National Forest can use this information to more effectively participate in decisions affecting the environment of the forest.

The survey area includes some privately owned urban and agricultural lands. This survey was not designed to provide information to be used in planning uses of these lands. Additional information can be obtained from the local office of the Natural Resources Conservation Service.

Soil Survey of Flathead National Forest Area, Montana

By Albin H. Martinson and William J. Basko

Field work by Albin H. Martinson, William J. Basko, Dean Sirucek, Jack Coyner, Larry Ross, and Gary Ford

United States Department of Agriculture,
Forest Service and Natural Resources Conservation Service,
in cooperation with the
Montana Agricultural Experiment Station

The survey area is in northwest Montana (fig. 1). It includes most of Flathead National Forest and Swan River, Coal Creek, and Stillwater State Forests which are administered by the Montana Department of State Lands. It also includes private land, which is intricately mixed with the land in the national and state forests. The total area of this survey is 1,613,290 acres. The survey area consists of forested mountains with relatively narrow valleys along major streams. The Flathead River is the principal drainageway. It is part of the Columbia River basin.

National Forests are managed for recreation, wildlife, timber production, watershed, and livestock grazing. Most national forest land is open for mineral exploration and development. The included areas of state and privately owned land are mostly forested and are managed for many of the same uses as the land in the national forests.

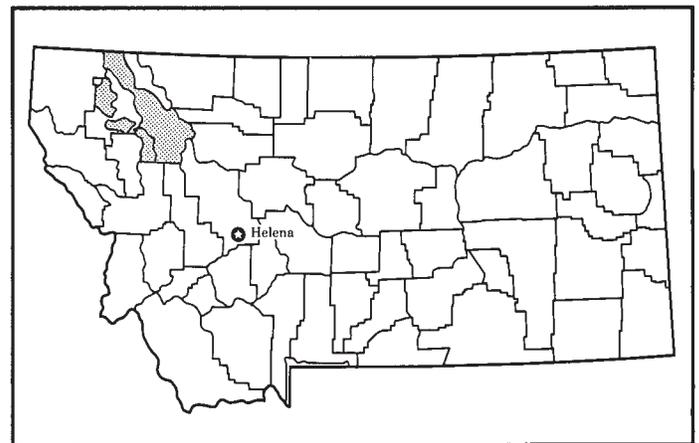


Figure 1.—Location of Flathead National Forest area.

General Nature of the Survey Area

This section provides general information about the survey area. It describes history and development, natural resources, climate, physiography, geology, and vegetation.

History and Development

The Kootenai and a number of Salish speaking tribes hunted and gathered food in the survey area prior to European settlement. In 1811, David Thompson of the Northwest Trading Company established a trading post

near Kalispell, MT. Further European settlement was sporadic until the late 1800's when the Great Northern Railroad reached the survey area.

In 1887 President Grover Cleveland established the Lewis and Clark Forest Reserve. In 1906 a part of this reserve became the Flathead National Forest.

Natural Resources

About 128 million board feet of timber is cut annually from Douglas-fir, Engelmann spruce, western larch, lodgepole pine, western white pine, grand fir, ponderosa

pine, and western redcedar trees. Small quantities of posts, poles and house logs are also produced.

The area provides habitat for more than 350 wildlife species. Elk, moose, whitetail and mule deer, bighorn sheep, mountain goat, black bear, grizzly bear, mountain lion, and a variety of small mammals and birds inhabit the survey area. Streams, reservoirs, and lakes provide habitat for rainbow, cutthroat, lake, and brook trout; mountain whitefish; and kokanee salmon.

The watersheds in the survey area are part of the Columbia River system. The water produced is used for recreation, fisheries, irrigation, and power generation. Water quantity is adequate for current uses and water quality has, historically, been excellent.

Recreational opportunities include hunting, fishing, camping, hiking, cross-country skiing, rock climbing, berry picking, and river rafting.

Cattle graze on transitory ranges created by logging or forest fires.

There has been copper, silver, and gold exploration in the survey area but there has been no commercial development of these resources. Deposits of coal are in the area but have not yet been mined. Much of the survey area has been leased for oil and gas production and several exploratory wells have been drilled.

Climate

The climate of the survey area is strongly influenced by Pacific maritime weather systems. Winters are generally cloudy, cool, and wet. November, December, and January are generally the wettest months. Most of the snowpack at higher elevations accumulates during the period of December through April. If rain falls on the snowpack during winter, flooding can occur. This flooding causes more damage than flooding which occurs after spring snowmelt. It also causes some of the most severe damage.

In summer, days are warm and dry and nights are cool. Occasional late afternoon thunderstorms occur on hot summer days.

The average annual precipitation is about 16 inches at Kalispell and about 100 inches on the highest mountain ridges. The mountains receive about 80 percent of their precipitation as snow. The average annual temperature at Kalispell is 42.8 degrees F.

Climatic conditions in mountainous areas are extremely variable over short distances because of local topographic effects. "Frost pockets" are an example of a local topographic effect. Cold air is trapped in low areas on summer nights causing frequent summer frosts. Temperature inversions are common in valleys during winter. They occur when cold air is trapped in valleys

under warmer air that is at higher elevations. Temperature inversions can cause fog and trap pollutants in the valleys.

Physiography

The survey area is within the Northern Rocky Mountain physiographic province. It includes five mountain ranges and intervening narrow valleys (fig. 2). The mountain ranges are the Whitefish, Salish, Mission, Flathead, and Swan Ranges. The survey area is drained by three major rivers—the Flathead, Stillwater, and Swan Rivers.

Most of the survey area has been glaciated by continental ice sheets. Continental ice sheets advanced several times during the Pleistocene epoch. The last one retreated about 10,000 years ago. The higher mountains that were not overridden by the continental ice sheets were subjected to intense alpine glaciation.

Most landforms in the survey area have been influenced by glaciation. Glacial cirques, U-shaped glacial valleys, moraines, and terraces are examples of landforms that formed in glacial lake sediments or outwash.

Each detailed soil map unit in this survey is on a characteristic landform. General soil map units are on combinations of landforms. Landform properties visible on aerial photography were often used to plot the boundaries of the map units. The landform properties of the map units can help map users identify map unit delineations.

The following classes of landforms were used to define map units and assist in mapping.

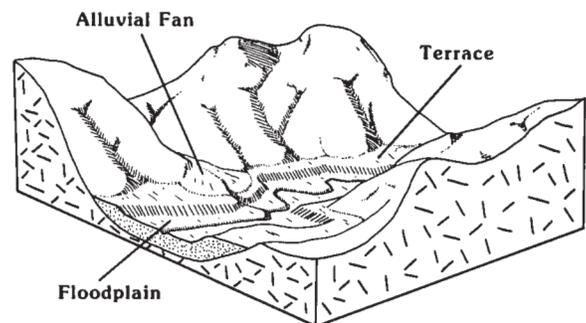


Figure 3.—Stream bottoms are floodplains, terraces, and alluvial fans in narrow mountain valleys. Large terraces and alluvial fans are mapped as separate landforms.

Stream bottoms are along major perennial streams (fig. 3). They include flood plains, low terraces, and alluvial fans. They are gently sloping. Soils on stream bottoms can have a water table and are usually subject to flooding.

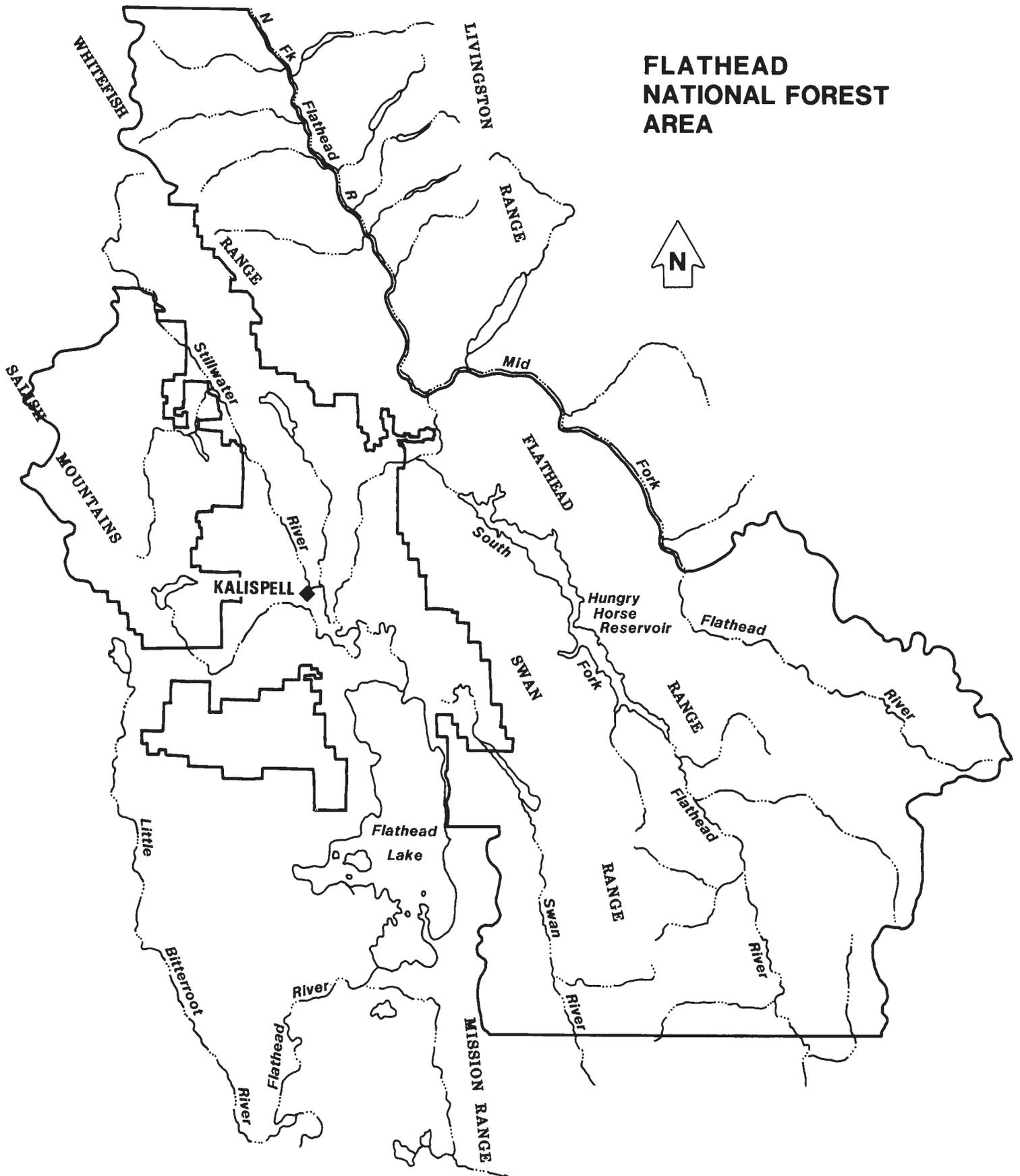


Figure 2.—Physiographic features of the survey area.

Terraces are relatively flat surfaces bordering a valley floor (fig. 3). They represent the former position of an alluvial plain or lake bottom and can include steep risers between terrace surfaces and valley floors. They are formed by alluvial, glacial outwash, and lacustrine deposits.

Alluvial fans are formed by stream deposition in areas where channel gradients rapidly decrease. They are in areas where a stream emerges from a narrow mountain valley onto a broader valley bottom or plain (fig. 3). They are smooth, convex, fan-shaped deposits. Their apex is at the mouth of the stream. Alluvial fans are dissected by poorly defined, intermittent streams 1,000 to 5,000 feet apart. The drainage system has braided channels with moderate gradients. Alluvial fans have no major changes in slope aspect.

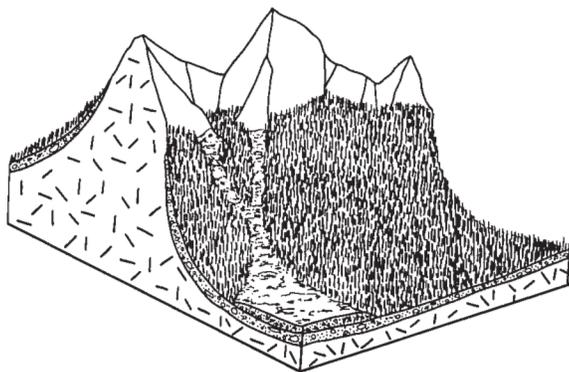


Figure 4.—An avalanche debris fan at the base of an avalanche chute.

Avalanche debris fans are steep deposits of avalanche debris at the base of avalanche paths on glacial trough walls (fig. 4). Dominant slope gradients are 20 to 50 percent. These deposits contain many angular rock fragments. There are no surface drainages on these permeable deposits.

Landslide deposits are deposits resulting from rotational slumps, earthflows and block glides (fig. 5). They have a hummocky surface with cracks, slump escarpments, and undrained depressions. Some have randomly oriented large blocks of rock. Slopes are very complex with benches and escarpments. The drainage pattern is deranged. There are many seeps, springs, and bogs.

Moraines are glacial drift deposits that have a topography characterized by randomly oriented mounds and depressions (fig. 6). Surface drainage is poor, and many depressions do not have an outlet.

Kames and kettles are distinctive morainic landscapes composed of moundlike hills of glacial drift, or kames, in a complex pattern with bowl-shaped depressions, or kettles

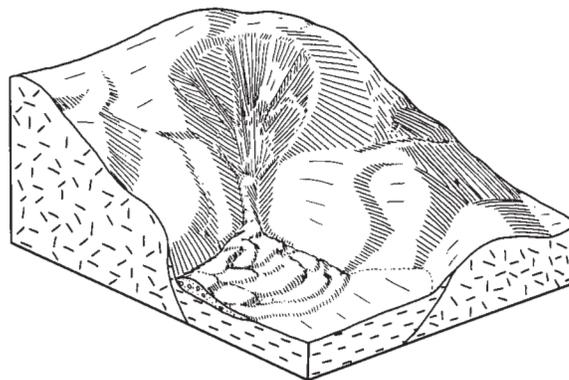


Figure 5.—A landslide deposit resulting from an earthflow.

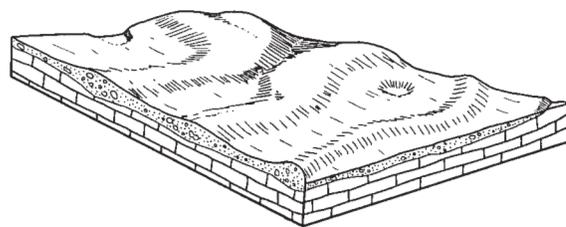


Figure 6.—A hummocky and hilly moraine.

(Fig. 7). Kettles may have been formed by the melting of large blocks of ice buried in the drift. Most kettles have no drainage outlet. Soils on kames and in kettles have a fluctuating water table.

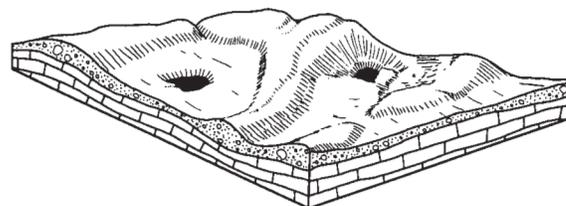


Figure 7.—An area of kames and kettles.

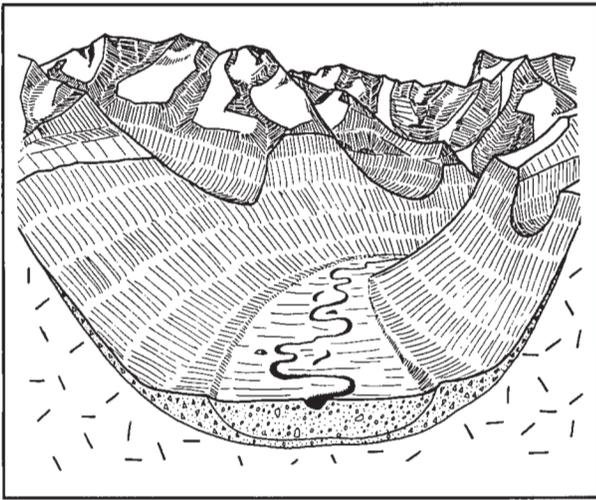


Figure 8.—Glacial trough walls in a U-shaped valley.

Glacial trough walls are straight or concave slopes in U-shaped glacial valleys (fig. 8). The slopes are very steep, and there are avalanche chutes. Glacial scouring has resulted in areas of rock outcrop and in areas on the upper slopes where the soils are shallow. Deposits of glacial drift are common on the lower slopes.

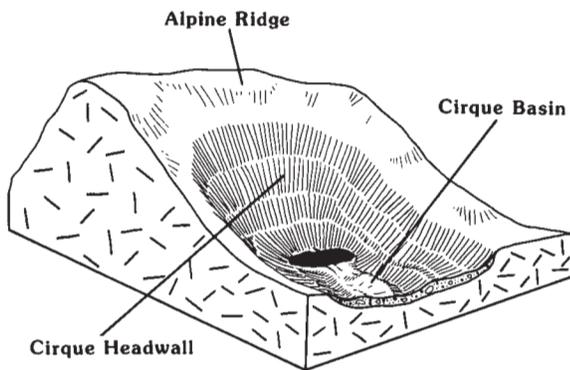


Figure 9.—Glacial cirques have very steep headwalls and a basin, which often contains a small lake. Alpine ridges are very

Cirque headwalls and alpine ridges are very steep rock cliffs surrounding glacial cirque basins and the very narrow ridges at the higher elevations above the cirques (fig.9). The cirques tend to be on northerly aspects and the alpine ridges on southerly aspects.

Cirque basins are characterized by low relief and were formed by glacial overriding with a combination of scouring and deposition of drift (fig. 9). These basins are found at the head of glacial valleys. They are semicircular and

contain scoured, striated outcrops of bedrock and thin, discontinuous deposits of glacial drift. They are dissected by widely spaced, poorly defined perennial and intermittent streams. Some cirque basins have small lakes.

Glaciated mountain ridges are rounded mountain ridges which have been overridden by glaciers (fig. 10). Glacial scouring has resulted in areas of rock outcrop and in areas on the ridge crest where the soils are shallow. Thick deposits of glacial till are on the lower slopes.

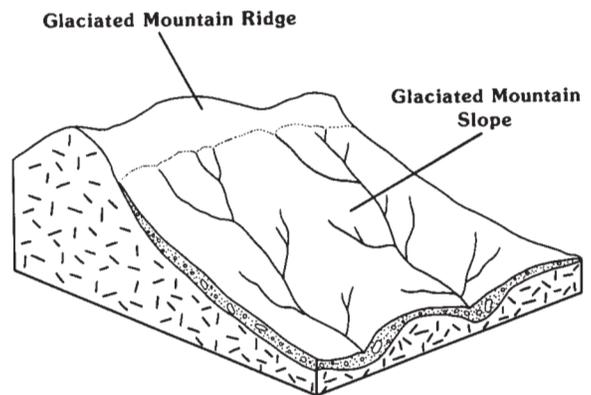


Figure 10.—Glaciated mountain slopes are mantled by glacial till. Rock outcrop and thin deposits of till are in areas of glaciated mountain ridges.

Glaciated mountain slopes are mantled by glacial till (fig. 10). The drainage pattern is usually dendritic, and the drainageways are widely spaced. Slopes are weakly to moderately dissected by low-order streams.

Structural breaklands have very steep slopes of more than 60 percent (fig. 11). A large amount of rock outcrop and talus is in many areas of breakland. The drainage pattern of breaklands is parallel to dendritic. Sediment delivery efficiency is high because of the steep drainage channels. The slope is a limitation in areas of breakland.

Stream breaklands are very steep, high relief slopes along major streams. Slope gradients are 60 to 90 percent. Stream breaklands form V shaped valleys along rapidly downcutting streams. Sediment delivery efficiency is very high on stream breaklands.

Geology

The bedrock in the survey area is predominantly metasedimentary rock of middle Proterozoic age. Quartzite, siltite and argillite and dolomite are the major kinds of rock.

Extensive surficial deposits of glacial till, outwash, and

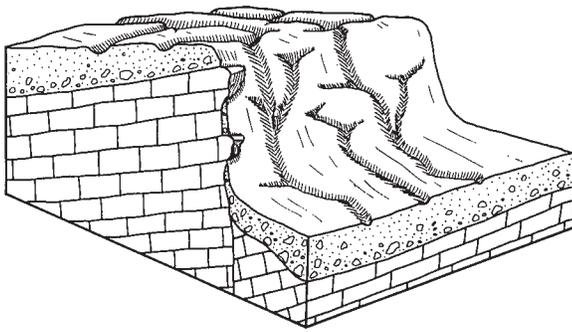


Figure 11.—The dip of underlying rock layers is roughly perpendicular to the slope of structural breaklands.

lacustrine sediments are in the survey area. The glacial till that was deposited by continental ice sheets tends to be dense and has bulk density of 1.5 to 1.8 grams per cubic centimeter.

Much of the survey area has a surface mantle of loess that has been influenced by volcanic ash. Most of the ash came from the eruption of Mt. Mazama in southwestern Oregon about 6,800 years ago. The layer of ash is on all northerly aspects and on southerly aspects above 4,500 feet.

The following geologic groups have similar associated landform and soil properties.

Alluvium is unconsolidated material sorted and deposited by water. The rock fragments are generally rounded. Alluvium forms flood plains, fans, and terraces along the major streams. Flooding, fluctuation of the water table, and the need to protect streambanks and channels can limit management of soils that formed in alluvium.

Lacustrine deposits are unconsolidated silts and clays deposited on glacial lake bottoms. These deposits are typically varved with thin sedimentary layers resulting from seasonal variations in deposition. They form terraces that have gently sloping surfaces and steep risers. Soils that formed in lacustrine sediments are erodible when they are exposed by excavation and have low strength when they are wet.

Glacial outwash is material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. It forms terraces that have nearly level surfaces and steep risers. Soils that formed in glacial outwash have sandy substrata containing rounded pebbles and cobbles.

Glacial till is unconsolidated deposits of clay, sand, gravel, and boulders deposited by a glacier. It forms moraines or mantles glaciated mountain slopes and ridges. Most soil substrata formed in glacial till are hard and brittle when they are moist and have bulk density of

1.5 to 1.8 grams per cubic centimeter. They restrict the penetration of roots and the movement of water.

Metasedimentary rocks are mainly argillites, quartzites, siltites, and dolomites of middle Proterozoic age. When weathered, these rocks produce loamy material containing many angular rock fragments. Soils that formed in material weathered from these rocks are on mountain slopes and ridges and glaciated mountain ridges. The content of angular rock fragments is 50 to 85 percent in soil substrata that formed in material weathered from metasedimentary rocks.

Vegetation

Most of the survey area is forested or has the potential to be forested. Ponderosa pine, Douglas-fir, western larch, grand fir, western white pine, lodgepole pine, western redcedar, subalpine fir, and Engelmann spruce are important tree species. Whitebark pine and alpine larch are important species at the highest elevations. Small sedge meadows are widely distributed in the major valleys throughout the survey area.

Habitat Types

Habitat types are considered to be basic ecologic subdivisions of landscapes. Each is recognized by distinctive combinations of overstory and understory plant species at climax. They are named for the dominant or characteristic vegetation of the climax community. Habitat types are useful in soil surveys when assessing the combined effects of aspect, slope, elevation, and soil properties on potential plant growth. The habitat types were important in estimating productivity and limitations to forest regeneration in this survey. Forest habitat types are defined in "Forest Habitat Types of Montana" (3).

Habitat types often have similar implications for the kind of interpretative uses made of them in soil surveys. Habitat types with similar implications for soil survey objectives are grouped in this report. Group names are used throughout the report. The groups are described in the following paragraphs.

Dry, mixed forest is made of habitat types on which forest stands are mostly Douglas-fir, western larch, and lodgepole pine. Ponderosa pine is included at lower elevations. Major habitat types are Douglas-fir/snowberry and Douglas-fir/pinegrass. Douglas-fir/dwarf huckleberry and Douglas-fir/twinflower are included in many of the map units and have similar management implications.

This habitat type group is moderately extensive. It is at lower elevations and on southerly aspects.

Moist, mixed forest is made of habitat types on which western white pine, western redcedar, and grand fir are potential stand components. Most of the other tree species

found in the survey area may also be included as stand components. The major habitat type is subalpine fir/queencup beadlily. Grand fir/queencup beadlily, western redcedar/queencup beadlily, subalpine fir/dwarf huckleberry, and subalpine fir/twinflower are all included in places and have similar management implications.

This habitat type group is extensive throughout the survey area.

Lower subalpine forest is made of habitat types on which forest stands are mostly lodgepole pine, Douglas fir, western larch, and subalpine fir. Major habitat types are subalpine fir/beargrass, blue huckleberry phase, lower elevation subalpine fir/Menziesia, and subalpine fir/grouse whortleberry.

This habitat type group is moderately extensive. It is on drier sites associated with the moist, mixed forest habitat type group.

Upper subalpine forest is made of habitat types on which forest stands are mostly whitebark pine, Engelmann spruce, subalpine fir, and occasionally alpine larch and lodgepole pine. Stands are closed canopy at lower elevations and open grown at higher elevations. Major habitat types are subalpine fir/beargrass, grouse whortleberry phase, subalpine fir/grouse whortleberry, grouse whortleberry phase, subalpine fir/woodrush, and whitebark pine-subalpine fir.

This habitat type group is moderately extensive. It is mainly at elevations above 5,500, but can be at lower elevations on ridges that are exposed to wind.

Wet forest is made of habitat types that receive additional water from flooding, the high water table, or seepage. Forest stands are mixed Engelmann spruce, subalpine fir, and lodgepole pine. Western white pine is also included in places. The major habitat types are subalpine fir/bluejoint, subalpine fir/sweet-scented bedstraw and, Engelmann spruce/common horsetail.

This habitat type group is of minor extent. It is mainly in valley bottoms throughout the survey area.

Wet meadows are a complex of community types dominated by sedges, rushes, and other grasses and forbs that grow on moist or wet sites.

How This Survey Was Made

The survey area is mountainous and heavily forested. Mapping techniques used in other survey areas were impractical because access in the area is difficult. The mapping techniques used relied heavily on plotting map unit boundaries using features visible on aerial photography. Most commonly, these features were landforms or natural vegetation. Also, geologic maps were studied and the elevation of the site was considered when the map unit boundaries were plotted. Observations were made along field transects and traverses through representative delineations of map units. Relationships between properties important to survey objectives and features visible on aerial photography were observed. Sometimes different features were used to plot map unit boundaries as a result of field checking. Reliable relationships between photographic features and map unit properties were established. These properties were observed and described in the field. Physical and chemical properties of soils that cannot be measured with field techniques are derived from laboratory characterization of soils within the survey area and similar soils in adjacent areas.

Table 1 lists the most important features used to plot the boundaries of the map units. Landform, slope, parent material, vegetation, aspect, elevation, and rock outcrop are described under the headings "Physiography", "Geology", and "Vegetation". The map units in this survey are described under the headings "General Soil Map Units" and "Detailed Soil Map Units."

General Soil Map Units

The general soil map at the back of this publication shows broad areas with similar topography and soil patterns. Typically, a map unit consists of one or more major soils and some minor soils.

The general soil map can be used to compare the suitability of large areas for common land uses. The map is not suitable for planning the use of small areas because of its small scale.

1. Soils on stream bottoms, terraces, and kames

This map unit is of minor extent along major rivers in the survey area. The landscape is characterized by nearly level stream bottoms, terraces, and rolling kames. Soils formed in alluvial and lacustrine deposits, glacial outwash and reworked glacial till. This map unit occupies about 8 percent of the survey area. It is about 60 percent Dystric Eutrochrepts, 17 percent Aquepts, 13 percent Fluvents, and 10 percent minor soils of minor extent.

The Dystric Eutrochrepts are on high terraces that have been formed by glacial outwash or on kames. They are not subject to flooding and are well drained. They support dry, mixed forest.

The Aquepts are in depressions on low terraces or stream bottoms. They have fluctuating water tables that rise to the surface in the spring and early summer. They support wet forest.

The Fluvents are on stream bottoms. They are subject to occasional, short-duration flooding in the spring. Some delineations have a water table that rises to within 24 inches of the surface in the spring. They support moist, mixed forest or dry, mixed forest.

The soils of minor extent are Borosaprists. They are in depressions and have formed in muck. They have water table levels that are near the surface all year. They support wet meadows.

Timber productivity is moderate to high in this map unit. The terrain is well suited to the operation of tractors. Forest regeneration is limited by wet soils, frost pockets, and plant competition. The protection of streambanks and channels is a major concern of watershed management.

2. Soils on moraines and glaciated mountains

This map unit is extensive in major valleys. The landscape is characterized by rolling to steep hills and low

relief mountains. The soils formed mainly in loess that has been influenced by volcanic ash and that is underlain by glacial till. In most places the till is dense and brittle when moist. The vegetation is mainly moist, mixed forest with some dry, mixed forest included at lowest elevations. This map unit occupies about 50 percent of the survey area. It is about 55 percent Andeptic Cryoboralfs, 15 percent Dystric Cryochrepts, 15 percent Andic Cryochrepts, and 15 percent soils of minor extent.

The Andeptic Cryoboralfs have a surface layer of loess that has been influenced by volcanic ash. It is 7 to 14 inches thick. They also have an accumulation of clay in the subsoil.

The Dystric Cryochrepts have a thin loess surface layer that has been mixed with subsoil material. The loess has been influenced by volcanic ash. These soils do not have an accumulation of clay in the subsoil and their lower soil layers are strongly acid to medium acid.

The Andic Cryochrepts have a surface layer of loess that has been influenced by volcanic ash. It is 7 to 14 inches thick. These soils do not have an accumulation of clay in the subsoil. Their lower soil layers are slightly acid to moderately alkaline.

The Typic Eutroboralfs are soils of minor extent at low elevations. The Glossic Cryoboralfs are soils of minor extent that have formed in till derived from weathered rocks or soft sedimentary rocks.

Timber production is the major land use in this map unit. Timber productivity is high for most of the unit. Much of the terrain is suitable for the operation of tractors, however, operating tractors can damage the soil by compacting the soil surface layers.

3. Soils on cirques and alpine ridges

This map unit is extensive on the crests of higher elevation mountain ranges. The landscape is characterized by glacial cirques with very steep rocky headwalls and rolling to steep basins and mountain peaks. Some basins contain small lakes. Soils formed in loess that has been influenced by volcanic ash and underlain by material derived from metasedimentary rocks or glacial till. Vegetated areas are mainly upper subalpine forest. This map unit occupies about 18 percent of the survey area. It is about 50 percent rock outcrop and cirqueland, 25

percent Entic Cryandeps, 15 percent Andic Cryochrepts, and 10 percent soils of minor extent.

The Entic Cryandeps formed in loess that has been influenced by volcanic ash and mixed with rock fragments derived from the underlying bedrock. They have a depth of 20 to 60 inches over bedrock.

The Andic Cryochrepts have a surface layer of loess that has been influenced by volcanic ash. It is 7 to 14 inches thick. The lower soil layers formed in glacial till. They have a depth of 60 inches or more.

The Borosaprists are soils of minor extent. They are in depressions in cirque basins.

This map unit is scenic and has a relatively high value for recreational activities and wildlife habitat. It is an important source of late summer streamflow.

4. Soils on glacial trough walls and structural breaklands

This map unit is extensive on mid to low elevation mountains. The landscape is characterized by very steep slopes on high relief glacial trough walls or major fault escarpments. The soils have a surface layer of loess that has been influenced by volcanic ash. The lower soil layers formed in material derived from underlying metasedimentary rocks or glacial till. The vegetation ranges from upper subalpine forest on upper slopes to moist, mixed or dry, mixed forest on lower slopes. This

map unit occupies about 24 percent of the survey area. It is about 30 percent Andic Cryochrepts, 25 percent rock outcrop, 20 percent Ochrepts, 10 percent Andeptic Cryoboralfs, and 15 percent soils of minor extent.

The Typic Cryochrepts are on upper trough walls. They have a surface layer of loess that has been influenced by volcanic ash. It is 7 to 14 inches thick. These soils have a depth of 20 to 60 inches over bedrock.

Ochrepts are on structural breaklands. They have a surface layer of loess that has been influenced by volcanic ash. The loess ranges in thickness from a thin layer mixed with subsoil material to a layer 14 inches deep. These soils have a depth of 20 to 60 inches over bedrock.

Andeptic Cryoboralfs are on lower trough walls. They have a surface layer of loess 7 to 14 inches thick. The loess has been influenced by volcanic ash. The lower soil layers formed in glacial till. They have a depth of 60 inches or more.

The Aquepts are soils of minor extent. They are in drainages.

Timber productivity ranges from high on lower trough walls to low on upper slopes on structural breaks. The slope limits the use of this map unit. Road construction is limited by hard bedrock within the excavated depth. Some south-facing, lower elevation slopes are important wildlife winter range.

Detailed Soil Map Units

This section describes each map unit in detail. The map unit descriptions, along with the soil maps, can be used to determine the suitability and potential of a unit for major land uses within the survey area, to plan land use and the development of resources, and to help protect and maintain the quality of the environment. The acreage of each map unit is given in table 8. Table 8 also provides a numerical listing of the detailed soil map unit names. Many of the terms used to describe map units are defined in the "Glossary." More information for each map unit is given under the heading "Use and Management of the Soils".

Most of the soils in the survey area are mapped at the family level of taxonomy, but a few are mapped at the higher levels. Map units in which soils were mapped at the family level are named using subgroup reference taxa for brevity. Table 2 gives the classification of the soils in each of the detailed soil map units.

The map unit description format presents information in sections. A description of the content of each section follows.

An introductory paragraph provides a summary of the map unit information. It describes landform, elevation, vegetation, and parent material.

Landform gives properties of the landform in the map unit. Slope gradient, the pattern and density of drainageways, and a description of the drainage channels are given. Seeps, springs, lakes, and other landform features that occur also are described.

Vegetation and *habitat types* describe the typical existing vegetation and the composition and distribution of habitat types. Major and similar habitat types are in the same habitat type group and have similar interpretive values for survey objectives. Included habitat types have similar productivity as major habitat types, but they can have different stand composition. Dissimilar habitat types have significantly different potential productivity or limitations to forest regeneration than the major habitat types.

Geology describes the bedrock underlying the soils or the properties of the geologic deposits in which the soils formed. The use of geology in defining, describing, and interpreting map units is described in the section "General Nature of the Survey Area".

Characteristics of the soils describes the soil properties that are of particular importance to use and management. The properties given are the same for the dominant soils and the similar soils in the unit. The texture of the surface layer, the thickness of the surface layer when it is loess that has been influenced by volcanic ash, the content of rock fragments in the subsoil, drainage, and depth to bedrock, if less than 60 inches, are important properties in this survey area. When the map unit is a complex, the most important properties of the soils and any relationship of the soils to topographic position or vegetation are described.

Map unit composition describes the soils that are similar and dissimilar to the dominant soils. It gives the percentage of the map unit typically occupied by the dominant and similar soils and by the dissimilar soils. The location and principal interpretive difference are given for dissimilar soils.

Representative profile of the soils describes the dominant soils in the map unit. It is not necessarily the same as the representative pedon for the taxa.

Management gives suitability and limitations for common land used. *Timber*, *roads*, and *watershed* are described.

10-2 Fluents, stream bottoms

This map unit is on stream bottoms. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is moist, mixed forest and dry, mixed forest. The soils formed in alluvial deposits.

Landform

The dominant slopes have gradients of 0 to 5 percent. The stream bottoms are along streams and are subject to flooding in spring when the snow melts. The streams have braided channels and change course frequently.

Vegetation

The vegetation is a mixed forest of subalpine fir, Engelmann spruce, Douglas-fir, western white pine, western larch and lodgepole pine. The forest understory is dominated by tall shrubs and a wide variety of forbs and grasses. Occasional flooding disturbs the vegetation. As a

result of the flooding, the vegetation is a mixture of shrubs, deciduous forest, and coniferous forest in different successional stages. Generally, about 20 percent of the unit supports shrubs.

Habitat Types

Subalpine fir/dwarf huckleberry and subalpinefir/queencup beadlily are the major habitat types in the low areas. Engelmann spruce/queencup beadlily is a similar habitat type. These habitat types are in about 50 percent of the unit. Douglas-fir/snowberry is the major habitat type at slightly higher elevations. This habitat type is in about 30 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Shrub communities are on areas disturbed by flooding. Wet meadows are in depressions.

Geology

These soils are underlain by stratified alluvial deposits of sand, silt, and gravel.

Characteristics of the Soils

These soils are subject to occasional flooding in the spring when the snow melts. The water table fluctuates between depths of 24 and 60 inches. The subsoil contains rounded rock fragments.

Map Unit Composition

The dominant soils are Fluvents. Similar soils are Ochrepts. Unlike the Fluvents, the Ochrepts have a weakly developed subsoil. The dominant and similar soils make up about 90 percent of the unit.

Dissimilar soils and river wash make up about 10 percent of the unit. Dissimilar soils are Borosaprists and Aquepts. The Borosaprists are in wet meadows. These soils formed in organic deposits. The Aquepts are in low-lying positions on the landscape. They are wet and have low strength.

Representative Profile of the Soils

No one profile can represent the dominant soils in this unit. In one of the most common profiles, however, the soils have a very dark grayish brown surface layer. This surface layer is about 10 inches thick. The upper part of the surface layer is loamy sand about 8 inches thick. The lower part is loam about 2 inches thick. The substratum to a depth of 60 inches or more is stratified weak red and brown loamy fine sand, loamy sand, and extremely gravelly sand.

Management

Timber

The potential annual production is high in low areas and

moderate at slightly higher elevations on the landscape. During site preparation stones and cobbles from the subsoil can be mixed with the soil in the surface layer. These stones and cobbles can affect planting. Regeneration of the forest is limited by frost pockets in low areas.

Roads

Floods can damage bridges and culverts.

Watershed

The major concern of watershed management is the protection of streambanks and channels. Carefully locating bridges and culverts helps to maintain the stability of the channels. Changes in the channel can result in a large amount of sediment. Disturbing the soils on or adjacent to the streambanks can result in severe sedimentation.

10-3 Aquepts, stream bottoms

This map unit is on stream bottoms. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is wet forest. The soils formed in alluvial deposits.

Landform

The dominant slopes have gradients of 0 to 5 percent. Stream bottoms are along streams and are subject to flooding in spring when the snow melts. This unit is in depressions on flood plains. Some units contain shallow ponds.

Vegetation

The vegetation is a spruce forest with some subalpine fir, western white pine and lodgepole pine near delineation boundaries. The forest understory is dominated by water tolerant grasses, forbs and shrubs.

Habitat Types

Subalpine fir/bluejoint and subalpine fir/sweet scented bedstraw are the major habitat types. Spruce/common horsetail is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/dwarf huckleberry, Douglas-fir/dwarf huckleberry and subalpine fir/queencup beadlily are on well drained soils. These soils support moist, mixed forest. Wet meadows are in some low areas.

Geology

These soils are underlain by stratified alluvial deposits of sand, silt and gravel.

Characteristics of the Soils

These soils are subject to flooding in the spring when the snow melts. The water table fluctuates, rising to the surface in spring and early summer. The subsoil contains rounded rock fragments.

Map Unit Composition

The dominant soils are Aquepts. Similar soils are Aquents. Unlike the Aquepts, the Aquents do not have a subsoil. The dominant and similar soils make up about 80 percent of the unit.

Dissimilar soils make up about 20 percent of the unit. They are Borosaprists, Fluvents, and fine-silty, mixed, frigid Typic Eutrochrepts. The Borosaprists are in wet meadows. They formed in organic deposits. The Fluvents are on knolls and low terraces. They have a water tables that fluctuates between depths of 24 and 60 inches. These soils support moist, mixed forest. The fine-silty, mixed, frigid Typic Eutrochrepts formed in lacustrine deposits. These soils support moist, mixed forest.

Representative Profile of the Soils

No one profile can represent the dominant soils in this unit. In one of the most common profiles, however, the soils have a surface layer of dark grayish brown loam about 7 inches thick. The subsoil is dark gray sandy loam about 11 inches thick. It is mottled with yellowish brown. The substratum to a depth of 60 inches or more is grayish brown extremely gravelly sand. It is also mottled with yellowish brown.

Management

Timber

The potential annual production is moderate in forested areas. The operation of tractors is limited in wet areas that have low strength. Compaction and the formation of ruts are hazards. Regeneration of the forest is limited by wet soils, frost pockets in low areas, and competition from blue joint. Trees are susceptible to windthrow because the water table limits root penetration.

Roads

The wetness is a limitation affecting the location and construction of roads. Providing suitable subgrade material helps to prevent the damage caused by wetness and low strength. Flooding can damage bridges and culverts.

Watershed

The major concern of watershed management is the protection of streambanks and channels. Carefully locating bridges and culverts helps to maintain the stability of the channels. Changes in the channel can result in a large

amount of sediment. Disturbing the soils on or adjacent to the streambanks can result in severe sedimentation.

12 Borosaprists, depressions

This map unit is in depressions on terraces, flood plains, and moraines. Elevation ranges from 3,000 to 5,100 feet. The average annual precipitation is 20 to 40 inches. Vegetation is wet meadows. The soils formed in organic deposits.

Landform

The dominant slopes have gradients of 0 to 2 percent. The depressions do not have well defined drainage outlets. Some contain shallow ponds.

Vegetation

The vegetation is mostly a wet meadow community dominated by sedges and water tolerant grasses. Some Engelmann spruce is around the edge of these wet meadows.

Habitat Types

The habitat types have not been defined for the vegetation in this unit. Subalpine fir/blue joint and spruce/ common horsetail habitat types are near delineation boundaries.

Geology

These soils are underlain by alluvial and lacustrine deposits or glacial drift.

Characteristics of the Soils

These soils formed in organic deposits of 10 to more than 60 inches thick. They have water tables at or near the surface for most of the year.

Map Unit Composition

The dominant soils are Borosaprists. They have an organic layer 16 to more than 60 inches thick. Similar soils are Aquents. They have an organic surface layer 10 to 16 inches thick. The dominant and similar soils make up about 100 percent of the unit.

Representative Profile of the Soils

The dominant soils have a black and very dark brown muck to a depth of 60 inches or more.

Management

Timber

This map unit contains only scattered stands of trees. It is poorly suited to woodland managed for timber.

Roads

The wetness is a limitation affecting the location and construction of roads. Providing suitable subgrade material helps to prevent the damage caused by wetness and low strength.

Watershed

Most of this unit is a riparian area and is potentially important to the watershed and wildlife. Conservation practices to protect riparian values should be required when managing adjacent uplands.

14-2 Glossic Cryoboralfs, lacustrine substratum

This map unit is on broad stream bottoms and in depressions on moraines. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is moist, mixed forest. The lower soil layers formed in lacustrine deposits.

Landform

The dominant slopes have gradients of 0 to 20 percent. Terraces have nearly level surfaces and short, steep risers. Depressions on moraines have concave slopes.

Vegetation

The vegetation is a mixed forest of subalpine fir, grand fir, spruce, lodgepole pine, western larch, Douglas-fir and western white pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/dwarf huckleberry is the major habitat type. Similar habitat types include subalpine fir/queencup beadlily and grand fir/queencup beadlily. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types and community types are in about 15 percent of the unit. Subalpine fir/bluejoint is on wet soils. Wet meadows are in depressions without drainage.

Geology

These soils are underlain by silty glacial lake sediments. The sediments have thin dark colored layers alternating with lighter colored layers.

Characteristics of the Soils

These soils have medium textured, loess surface layers 2 to 12 inches thick. The loess has been influenced by volcanic ash.

Map Unit Composition

The dominant soils are fine-silty, mixed Glossic

Cryoboralfs. They have a surface layer of loess 2 to 7 inches thick. The similar soils are fine-silty, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 12 inches thick. The dominant and similar soils make up about 85 percent of the map unit.

Dissimilar soils make up about 15 percent of the unit. They are fine-silty, mixed Aquic Cryoboralfs and Borosaprists. The Aquic Cryoboralfs have mottles in the subsoil. They have a fluctuating water table and low strength. The Borosaprists are in wet meadows. They formed in organic deposits.

Representative Profile of the Soils

The dominant soils are fine-silty, mixed Glossic Cryoboralfs. They have a an upper surface layer of dark yellowish brown silt loam about 3 inches thick. They have a lower surface layer or light gray and pale yellow silt loam about 24 inches thick. The subsoil is light yellowish brown silt loam about 18 inches thick. The substratum to a depth of 60 inches or more is light gray silt loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced or it can be mixed with subsoil material. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by frost pockets in low areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a severe hazard of erosion. The sediment that results from the erosion of these soils is particularly damaging to the spawning habitat of fish. Sediment delivery efficiency is low.

14-3 Aquepts, lacustrine substratum

This map unit is on broad stream bottoms and in depressions on terraces and moraines. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is wet forest. The soils formed in lacustrine deposits.

Landform

The dominant slopes have gradients of 0 to 5 percent. These depressions have no well defined drainage outlet.

Vegetation

The vegetation is a mixed forest of subalpine fir, Engelmann spruce and lodgepole pine. The forest understory is dominated by grass and low shrubs. Bluejoint is common.

Habitat Types

Subalpine fir/bluejoint and subalpine fir/dwarf huckleberry are the major habitat types. Spruce/common horsetail is a similar habitat type. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types and community types are in about 15 percent of the unit. Subalpine fir/queencup beadlily is on well drained sites. Their productivity for timber is higher than that of the major habitat types. Wet meadows are in poorly drained depressions.

Geology

These soils are underlain by silty glacial lake sediments. The sediments have thin dark colored layers alternating with lighter colored layers.

Characteristics of the Soils

These soils have medium textured surface layers. The subsoils contain 0 to 15 percent rounded rock fragments. These soils have fluctuating water tables which are at or near the surface during spring and early summer.

Map Unit Composition

The dominant soils are Aquepts. They have a weakly developed subsoil. Similar soils are Aquents. They do not have a subsoil. The dominant and similar soils make up about 85 percent of the map unit.

Dissimilar soils make up about 15 percent of the unit. They are Glossic Cryoboralfs and Borosaprists. The Glossic Cryoboralfs are near the edges of depressions. They are well drained and have a higher timber productivity. The Borosaprists are in wet meadows. They formed in organic deposits.

Representative Profile of the Soils

No one profile can represent the soils in this unit. In one of the most common profiles, however, the soils have a surface layer of light brownish gray mottled with yellowish brown and strong brown silt loam about 11 inches thick. The subsoil is light yellowish brown mottled with strong brown and pinkish gray silt. The substratum to a depth of 60 inches or more is light gray and pale yellow silt.

Management

Timber

The potential annual production is moderate. The operation of tractors is limited in wet areas that have low strength. Compaction and the formation of ruts are hazards. Using cable logging systems or logging with tractors on snow or frozen ground, help to overcome these limitations. Regeneration of the forest is limited by wet soils, frost pockets, and competition from bluejoint. Trees are susceptible to wind throw because the water table limits root penetration.

Roads

The wetness is a limitation affecting the location and construction of roads. Providing suitable subgrade material helps to prevent the damage caused by wetness and low strength.

Watershed

Most of this unit is a riparian area and potentially important to watershed and wildlife. Conservation practices to protect riparian values should be required when managing adjacent uplands.

16 Fluvents, alluvial fans

This map unit is on alluvial fans. Elevation ranges from 3,100 to 4,800 feet. The average annual precipitation is 20 to 40 inches. The vegetation is moist, mixed forest. The soils formed in alluvial deposits.

Landform

The dominant slopes have gradients of 5 to 25 percent. Alluvial fans are fan-shaped alluvial deposits at the point where steep mountain streams enter valley bottoms. Seeps and springs are in drainages.

Vegetation

The vegetation is a mixed forest of subalpine fir, grand fir, Douglas-fir, ponderosa pine, western larch and lodgepole pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Grand fir/queencup beadlily is similar. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Douglas-fir/snowberry is on low elevation, southerly aspects and has lower timber productivity. Subalpine fir/

bluejoint is around seeps and springs where wet soils limit forest regeneration.

Geology

These soils are underlain by stratified alluvial deposits of sand, silt, gravel and cobbles.

Characteristics of the Soils

These soils have fluctuating water tables that rise to within 24 to 60 inches of the surface, in the spring when the snow melts.

Map Unit Composition

The dominant soils are Fluvents. They have surface layers that formed in alluvium. Similar soils are Andeptic Cryorthents. They have surface layers that formed in loess. The loess has been influenced by volcanic ash. The dominant and similar soils make up about 90 percent of the map unit.

Dissimilar soils make up about 10 percent of the unit. They are Aquepts. The Aquepts are in drainages and around seeps and springs. They have mottled substrata and a water table that rises to within 12 inches of the surface during the spring.

Representative Profile of the Soils

No one profile can represent the dominant soils in this unit. In one of the most common profiles, however, the soils have a surface layer of dark grayish brown loamy sand and loam about 10 inches thick. The substratum to a depth of 60 inches or more is brown and weak red stratified loamy sand and extremely gravelly sand.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced or it can be mixed with subsoil material. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered.

Roads

This unit contains seeps and springs. Excavation can intercept large amounts of ground water. The material exposed in cutbanks during road construction tends to ravel if the slopes are steep.

Watershed

Sediment delivery efficiency is low.

17 Ochrepts, avalanche debris fans

This map unit is on avalanche debris fans. Elevation is 3,500 to 5,500 feet. Average annual precipitation is 30 to 60 inches. The vegetation is shrub communities. The soils formed in avalanche debris.

Landform

The dominant slopes have gradients of 20 to 50 percent. Avalanche debris fans are fan-shaped run-out areas at the base of avalanche paths. Seeps and springs are common near the lower edge of fans.

Vegetation

The vegetation is dominantly alder and Menziesia with some subalpine fir saplings.

Habitat Types

Subalpine fir/Menziesia and subalpine fir/Sitka alder are the major habitat types. Disturbance by avalanches keeps the vegetation a shrub community.

Geology

These soils are underlain by stratified deposits of silt, sand, gravel and cobbles.

Characteristics of the Soils

These soils have loamy textures. Subsoils contain 35 to 80 percent angular rock fragments.

Map Unit Composition

The dominant soils are Ochrepts. They have a weakly developed subsoil. Similar soils are Orthents. They have thin surface layers over substrata. The dominant and similar soils make up about 100 percent of the map unit.

Representative Profile of the Soils

No one profile can represent the dominant soils in this unit. In one of the most common profiles, however, the soils have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower subsoil to a depth of 60 inches or more is brown extremely gravelly loamy sand.

Management

Timber

This map unit contains only scattered stands of trees. It is poorly suited to woodland managed for timber.

Roads

This unit contains seeps and springs. Excavation can

intercept large amounts of ground water. The material exposed in cutbanks during road construction tends to ravel if the slopes are steep. Unsurfaced roads are rough because of large stones or cobbles. Avalanches can increase the costs of maintaining the roads.

Watershed

Sediment delivery efficiency is moderate.

21-8 Andic Cryochrepts-Entic Cryandeps-Rock outcrop complex, cirque basins

This map unit is in cirque basins. Elevation ranges from 5,500 to 7,000 feet. The average annual precipitation is 50 to 80 inches. The vegetation is upper subalpine forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 20 to 40 percent. Cirque basins are rolling to hilly basins at the head of U-shaped valleys. The drainage pattern is dendritic and has widely spaced low order drainages. In some areas there are small lakes, seeps, and springs.

Vegetation

The vegetation is a mixed forest of subalpine fir, whitebark pine, Engelmann spruce, and lodgepole pine. The forest understory is dominated by forbs and large shrubs.

Habitat Types

Subalpine fir/wood-rush, Menziesia phase and whitebark pine-subalpine fir are the major habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/grouse whortleberry and subalpine fir/Menziesia are on northerly aspects. Subalpine fir/beargrass is on southerly aspects. Their productivity for timber is higher than that of the major habitat types. Wet meadows are in drainageways and depressions.

Geology

These soils are underlain by argillites, limestones and quartzites of the Belt Supergroup. Friable glacial till overlies the bedrock on concave lower slopes and in depressions.

Characteristics of the Soils

These soils have medium textured, loess surface layers. 4 to 40 inches thick. The loess has been influenced by volcanic ash. Soil properties vary with topographic

position. Soils on concave lower slopes and in depressions have loess surface layers 4 to 14 inches thick and are more than 60 inches deep. Their subsoils contain 35 to 80 percent rounded rock fragments. Soils on convex ridges, knolls, and basin thresholds formed in loess, or loess mixed with residuum, and are 20 to 60 inches deep. Their subsoils contain 35 to 80 percent angular rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andic Cryochrepts and medial-skeletal, Entic Cryandeps. The Andic Cryochrepts are on concave lower slopes and in depressions. They have a surface layer of loess 7 to 14 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. The Entic Cryandeps are on convex ridges, knolls and basin thresholds. They have a depth of 20 to 60 inches. Similar soils are medial-skeletal, Lithic Cryandeps. They have a depth of 10 to 20 inches over bedrock. The dominant and similar soils make up about 70 percent of the map unit.

Rock outcrop is on ridges, knolls and thresholds. It makes up about 20 percent of the unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up about 10 percent of this unit. The dissimilar soils are Borosaprists. The Borosaprists support wet meadows. They formed in organic deposits.

Representative Profile of the Soils

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly silt loam about 4 inches thick. The upper part of the subsoil is brown very gravelly silt loam about 8 inches thick. The lower part to a depth of 60 inches or more is brown extremely gravelly silt loam.

The medial-skeletal Entic Cryandeps have a surface layer of black and brown gravelly silt loam about 4 inches thick. The upper part of the subsoil is yellowish brown very gravelly silt loam about 13 inches thick. The lower part is yellowish brown and brownish yellow extremely gravelly silt loam to a depth of about 40 inches over bedrock.

Management

Timber

The potential annual production is low in forested areas. Productivity in the map unit is limited by the Rock outcrop. Although the terrain is suited to the operation of tractors, the Rock outcrop and broken slopes limit tractor operation on this site. Likewise, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced or it can be mixed with subsoil material. Soils on concave lower slopes are

normally not dry enough to support tractors without compacting. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by the harsh subalpine climate.

Roads

Hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. The material exposed during road construction is difficult to revegetate because of the harsh climate and moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is low. Winter rain on snow can cause runoff and erosion of disturbed soils.

21-9 Andic Cryochrepts-Entic Cryandeps-Rock outcrop complex, cirque basins, steep

This map unit is in cirque basins. Elevation ranges from 5,500 to 7,000 feet. The average annual precipitation is 50 to 80 inches. The vegetation is upper subalpine forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 40 to 60 percent. Cirque basins are hilly to steep basins at the head of U-shaped valleys. The drainage pattern is dendritic and has widely spaced low order drainages. In some areas there are small lakes, seeps, and springs.

Vegetation

The vegetation is a mixed forest of subalpine fir, whitebark pine, Engelmann spruce, and lodgepole pine. The forest understory is dominated by forbs and large shrubs.

Habitat Types

Subalpine fir/wood-rush, Menziesia phase and whitebark pine-subalpine fir are the major habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/grouse whortleberry and subalpine fir/Menziesia are on northerly aspects. Subalpine fir/beargrass is on southerly aspects. Their productivity for timber is higher than that of the major

habitat types. Wet meadows are in drainageways and depressions.

Geology

These soils are underlain by argillites, limestones and quartzites of the Belt Supergroup. Friable glacial till overlies the bedrock on concave lower slopes and in depressions.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 40 inches thick. The loess has been influenced by volcanic ash. Soil properties vary with topographic position. Soils on concave lower slopes and in depressions have loess surface layers 4 to 14 inches thick and are more than 60 inches deep. Their subsoils contain 35 to 80 percent rounded rock fragments. Soils on convex ridges, knolls, and basin thresholds formed in loess or loess mixed with residuum, and are 20 to 60 inches deep. Their subsoils contain 35 to 80 percent angular rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andic Cryochrepts and medial-skeletal, Entic Cryandeps. The Andic Cryochrepts are on concave lower slopes and in depressions. They have a surface layer of loess 7 to 14 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. The Entic Cryandeps are on convex ridges, knolls and basin thresholds. They have a depth of 20 to 60 inches. Similar soils are medial-skeletal, Lithic Cryandeps. They have a depth of 10 to 20 inches over bedrock. The dominant and similar soils make up about 70 percent of the unit.

Rock outcrop is on ridges, knolls and thresholds. It makes up about 20 percent of the unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up about 10 percent of the unit. They are Borosaprists. The Borosaprists are in wet meadows. They formed in organic deposits.

Representative Profile of the Soils

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly silt loam 4 inches thick. The upper part of the subsoil is brown very gravelly silt loam about 8 inches thick. The lower part to a depth of 60 inches or more is brown extremely gravelly silt loam.

The medial-skeletal Entic Cryandeps have a surface layer of black and brown gravelly silt loam about 4 inches thick. The upper part of the subsoil is brown and yellowish brown very gravelly silt loam about 13 inches thick. The

lower part is yellowish brown and brownish yellow extremely gravelly silt loam to a depth of about 40 inches over bedrock.

Management

Timber

The potential annual production is low. Productivity in the map unit is limited by the Rock outcrop. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by the harsh subalpine climate.

Roads

Hard rock frequently limits excavation. Excavation of hard rock produces extremely stony cut and fill material with a low water-holding capacity. Unsurfaced roads are rough because of large stones and cobbles. Material exposed by road construction is difficult to revegetate because of moisture stress and harsh climate.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is low. Winter rain on snow can cause runoff and erosion of disturbed soils.

23-7 Andeptic Cryoboralfs-Andic Cryochrepts complex, rolling

This map unit is on glaciated mountain slopes and ridges. Elevation ranges from 3,000 to 7,000 feet. The average annual precipitation is 20 to 60 inches. The vegetation is moist, mixed forest and dry, mixed forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 10 to 20 percent. Glaciated mountain slopes and ridges are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch, western white pine and spruce. Western redcedar and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Habitat types vary with topographic position. Subalpine fir/queencup beadlily is the major habitat type on lower slopes. Western redcedar/queencup beadlily and grand fir/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 50 percent of the unit.

Douglas-fir/pinegrass is the major habitat type on upper slopes and ridges. Douglas-fir/snowberry is a similar habitat type that is on southerly aspects in low elevation delineations. These habitat types occupy about 40 percent of the unit.

Dissimilar habitat types and community types are in about 10 percent of the unit. Subalpine fir/beargrass is on southerly aspects at high elevations. It supports lower subalpine forest. Wet meadows are around seeps and springs in drainageways.

Geology

Soils on lower slopes are underlain by neutral and alkaline, dense, brittle glacial till. Soils on upper slopes and ridges are underlain by argillites, siltites and limestones of the Belt Supergroup.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 80 percent rock fragments. Soil properties vary with topographic position. Soils on lower slopes have subsoil clay accumulations and rounded subsoil rock fragments. Soils on upper slopes and ridges do not have subsoil clay accumulations and have angular subsoil rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs and loamy-skeletal, mixed Andic Cryochrepts. The Andeptic Cryoboralfs are on lower slopes. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The Andic Cryochrepts are on upper slopes and ridges. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15

percent of the unit. The Rock outcrop is on ridges and upper slopes. The dissimilar soils are Aquepts. The Aquepts are in drainageways. They are wet and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is dense, brittle brown very gravelly silt loam and loam.

The loamy-skeletal, mixed Andic Cryochrepts, have a surface layer of brown gravelly and very gravelly silt loam about 12 inches thick. The subsoil is yellowish brown extremely gravelly silt loam to a depth of 45 inches over fractured bedrock.

Management

Timber

The potential annual production is high on lower slopes and moderate on upper slopes and ridges. Although the terrain is well suited to the operation of tractors, tractor operation on lower slopes can lower productivity by compacting or displacing soil surface layers. Soil surface layers on lower slopes do not normally dry out enough to support tractors without compacting. Tractor operation should be carefully managed to minimize the area affected or confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained. On upper slopes, the material exposed during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion on upper slopes and a moderate hazard of erosion on lower slopes. Sediment delivery efficiency is moderate.

23-8 Andeptic Cryoboralfs-Andic Cryochrepts complex, hilly

This map unit is on glaciated mountain slopes and ridges. Elevation ranges from 3,000 to 7,000 feet. The

average annual precipitation is 20 to 60 inches. The vegetation is moist, mixed forest and dry, mixed forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes and ridges are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch, western white pine and spruce. Western redcedar and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Habitat types vary with topographic position. Subalpine fir/queencup beadlily is the major habitat type on lower slopes. Western redcedar/queencup beadlily and grand fir/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 50 percent of the unit.

Douglas-fir/pinegrass is the major habitat types on upper slopes and ridges. Douglas-fir/snowberry is similar on southerly aspects in low elevation delineations. These habitat types occupy about 40 percent of the unit.

Dissimilar habitat types and community types are in about 10 percent of the unit. Subalpine fir/beargrass is on southerly aspects at high elevation. Wet meadows are around seeps and springs in drainageways.

Geology

Soils on lower slopes are underlain by neutral and alkaline, dense, brittle glacial till. Soils on upper slopes and ridges are underlain by argillites, siltites and limestones of the Belt Supergroup.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 80 percent rock fragments. Soil properties vary with topographic position. Soils on lower slopes have subsoil clay accumulations and rounded subsoil rock fragments, and are 60 inches or more deep. Soils on upper slopes and ridges do not have subsoil clay accumulations, have angular subsoil rock fragments and are 40 to 60 inches deep.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs and loamy-skeletal, mixed Andic Cryochrepts.

The Andeptic Cryoboralfs are on lower slopes. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The Andic Cryochrepts are on upper slopes and ridges. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent of the unit. The Rock outcrop is on ridges and upper slopes. The dissimilar soils are Aquepts. The Aquepts are in drainageways. They are wet and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. The lower 18 inches of the surface layer is pale brown very gravelly silt loam. The upper part of the subsoil is brown very gravelly clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is dense, brittle brown very gravelly silt loam and loam.

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly and very gravelly silt loam about 12 inches thick. The subsoil is brown extremely gravelly silt loam to a depth of 45 inches over fractured bedrock.

Management

Timber

The potential annual production is high on lower slopes and moderate on upper slopes and ridges. Although the terrain is well suited to the operation of tractors, if tractors are operated on the lower slopes, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Regeneration of the forest on upper slopes and ridges is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained. On upper slopes and ridges, the material exposed during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion on upper slopes and a moderate hazard of erosion on lower slopes. Sediment delivery efficiency is moderate.

23-9 Andeptic Cryoboralfs-Andic Cryochrepts complex, steep

This map unit is on glaciated mountain slopes and ridges. Elevation ranges from 3,000 to 7,000 feet. The average annual precipitation is 20 to 60 inches. The vegetation is moist, mixed forest and dry, mixed forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes and ridges are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch, western white pine and spruce. Western redcedar and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Habitat types vary with topographic position. Subalpine fir/queencup beadlily is the major habitat type on lower slopes. Western redcedar/queencup beadlily and grand fir/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 50 percent of the unit.

Douglas-fir/pinegrass is the major habitat type on upper slopes and ridges. Douglas-fir/snowberry is similar on southerly aspects in low elevation delineations. These habitat types occupy about 40 percent of the unit.

Dissimilar habitat types and community types are in about 10 percent of the unit. Subalpine fir/beargrass is on southerly aspects at high elevation. Wet meadows are around seeps and springs in drainageways.

Geology

Soils on lower slopes are underlain by neutral and alkaline, dense, brittle glacial till. Soils on upper slopes and ridges are underlain by argillites, siltites and limestones of the Belt Supergroup.

Characteristics of the Soils

These soils have medium textured, loess surface layers

4 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 80 percent rock fragments. Soil properties vary with topographic position. Soils on lower slopes have subsoil clay accumulations rounded subsoil rock fragments, and have a depth of 60 inches or more. Soils on upper slopes and ridges do not have subsoil clay accumulations, have angular subsoil rock fragments, and are 40 to 60 inches deep.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs and loamy-skeletal, mixed Andic Cryochrepts. The Andeptic Cryoboralfs are on lower slopes. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The Andic Cryochrepts are on upper slopes and ridges. They have a surface layer of loess 7 to 12 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent of the unit. The Rock outcrop is on ridges and upper slopes. The dissimilar soils are Aquepts. The Aquepts are in drainageways. They are wet and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is dense, brittle brown very gravelly silt loam and loam.

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly and very gravelly silt loam about 12 inches thick. The subsoil is brown extremely gravelly silt loam to a depth of about 45 inches over fractured bedrock.

Management

Timber

The potential annual production is high on lower slopes and moderate on upper slopes and ridges. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest on upper slopes is limited by

plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained. On upper slopes and ridges, the material exposed during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion on upper slopes and a moderate hazard of erosion on lower slopes. Sediment delivery efficiency is moderate.

24-8 Dystric Cryochrepts, till substratum-Dystric Cryochrepts, residuum substratum complex, hilly

This map unit is on glaciated mountain slopes and ridges. Elevation ranges from 3,000 to 6,500 feet. The average annual precipitation is 20 to 60 inches. The vegetation is lower subalpine forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes and ridges are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch, western white pine and spruce. Western redcedar and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/beargrass is the major habitat type. This habitat type occupies about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and Douglas-fir/snowberry are on ridgetops and southerly aspects at lower elevations. Their productivity for timber is lower than that of the major habitat types.

Geology

Soils on lower slopes are underlain by acid, dense, brittle glacial till derived from quartzite and sandstone.

Soils on upper slopes and ridges are underlain by quartzites and sandstones.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 12 inches thick. The loess has been influenced by volcanic ash. Soil properties vary with topography. Soils on lower slopes have subsoils and substrata that contain 35 to 60 percent rounded rock fragments and have a depth of 60 or more inches. Soils on upper slopes and ridges have subsoils and substrata that contain 50 to 80 percent angular rock fragments and have a depth of 40 to 60 inches.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed, Dystric Cryochrepts, till substratum and loamy-skeletal, mixed Dystric Cryochrepts, residuum substratum. The Dystric Cryochrepts are on lower slopes. They have a surface layer of loess 4 to 7 inches thick. Similar soils are loamy-skeletal, mixed Andic Cryochrepts, till substratum. They have a surface layer of loess 7 to 12 inches thick. The Dystric Cryochrepts are on upper slopes and ridges. They have a surface layer of loess 4 to 7 inches thick. Similar soils are loamy-skeletal, mixed Andic Cryochrepts, residuum substratum. They have a surface layer of loess 7 to 12 inches thick. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent of the unit. The Rock outcrop is on ridges and upper slopes. The dissimilar soils are Aquepts. The Aquepts are near seeps and springs in drainages. They are wet and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed Dystric Cryochrepts, till substratum, are dark yellowish brown gravelly loam in the upper 6 inches of the surface layer. They are grayish brown very gravelly very fine sandy loam in the lower 8 inches of the surface layer. The subsoil is light brownish gray very gravelly very fine sandy loam about 13 inches thick. The substratum to a depth of 60 inches or more is light brownish gray very gravelly very fine sandy loam.

The loamy-skeletal, mixed, Dystric Cryochrepts, residuum substratum, are have a dark yellowish brown gravelly loam upper surface layer about 6 inches thick. The lower surface layer is grayish brown very gravelly very fine sandy loam about 8 inches thick. The subsoil is light brownish gray extremely gravelly very fine sandy loam about 13 inches thick. The substratum is light brownish gray extremely gravelly very fine sandy loam overlying bedrock at about 45 inches.

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the lower slopes, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Regeneration of the forest on upper slopes and ridges is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

The material exposed in cutbanks during road construction tends to ravel if the slopes are steep and is difficult to revegetate because of moisture stress. On upper slopes and ridges, the extremely gravelly substrata have a low water-holding capacity. On lower slopes, tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion on upper slopes and a moderate hazard of erosion on lower slopes. Sediment delivery efficiency is moderate.

24-9 Dystric Cryochrepts, till substratum-Dystric Cryochrepts, residuum substratum complex, steep

This map unit is on glaciated mountain slopes and ridges. Elevation ranges from 3,000 to 6,500 feet. The average annual precipitation is 20 to 60 inches. The vegetation is lower subalpine forest. The lower soil layers formed in glacial till and material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes and ridges are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch, western white pine and spruce. Western redcedar and grand fir are

included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/beargrass is the major habitat type. This habitat type occupies about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and Douglas-fir/snowberry are on ridgetops and southerly aspects at low elevations. Their productivity for timber is lower than that of the major habitat types.

Geology

Soils on lower slopes are underlain by acid, dense, brittle glacial till derived from quartzite and sandstone. Soils on upper slopes and ridges are underlain by quartzites and sandstones.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 12 inches thick. The loess has been influenced by volcanic ash. Soil properties vary with topography. Soils on lower slopes have subsoils and substrata that contain 35 to 60 percent rounded rock fragments and have a depth of 60 or more inches. Soils on upper slopes and ridges have subsoils and substrata containing 50 to 80 percent angular rock fragments and have a depth of 40 to 60 inches.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed, Dystric Cryochrepts, till substratum and loamy-skeletal, mixed, Dystric Cryochrepts, residuum substratum. The Dystric Cryochrepts are on lower slopes. They have a surface layer of loess 4 to 7 inches thick. Similar soils are loamy-skeletal, mixed, Andic Cryochrepts, till substratum. They have a surface layer of loess 7 to 12 inches thick.

The Dystric Cryochrepts are on upper slopes and ridges. They have a surface layer of loess 4 to 7 inches thick. Similar soils are loamy-skeletal, mixed, Andic Cryochrepts, residuum substratum. They have a surface layer of loess 7 to 12 inches thick. The dominant and similar soils make up about 85 percent of the unit.

The components of this unit occur in areas so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent of this unit. The Rock outcrop is on ridges and upper slopes. The dissimilar soils are Aquepts. The Aquepts are near seeps and springs in drainages. They are wet and support wet meadows.

Representative Profile of the Soils

Dystric Cryochrepts, loamy-skeletal, mixed, till substratum, are dark yellowish brown gravelly loam in the

upper 6 inches of the surface layer. They are grayish brown very gravelly very fine sandy loam in the lower 8 inches of the surface layer. The subsoil is light brownish gray very gravelly very fine sandy loam about 13 inches thick. The substratum to a depth of 60 inches or more is light brownish gray very gravelly very fine sandy loam.

The loamy-skeletal, mixed Dystric Cryochrepts, residuum substratum, are dark yellowish brown gravelly loam in the upper 6 inches of the surface layer. They are grayish brown very gravelly very fine sandy loam in the lower 8 inches of the surface layer. The subsoil is light brownish gray extremely gravelly very fine sandy loam about 13 inches thick. The substratum to a depth of about 45 inches is light brownish gray extremely gravelly very fine sandy loam over bedrock.

Management

Timber

The potential annual production is moderate. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest on upper slopes and ridges is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

The material exposed in cutbanks during road construction tends to ravel if the slopes are steep and is difficult to revegetate because of moisture stress. On upper slopes and ridges, the extremely gravelly substrata have a low water-holding capacity. On lower slopes, tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion on upper slopes and a moderate hazard of erosion on lower slopes. Sediment delivery efficiency is moderate.

26A-7 Andeptic Cryoboralfs, silty till substratum, calcareous, rolling

This map unit is on moraines. Elevation ranges from 3,000 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20

percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of Douglas-fir, lodgepole pine, western larch and western white pine. Western redcedar, Engelmann spruce, subalpine fir and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. However, grand fir/queencup beadlily and western redcedar/queencup beadlily are the major habitat types in some low elevation valleys. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are on kames and terraces. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 7 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic cryoboralfs. They have a content of rock fragments in the subsoil that ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Andeptic Cryoboralfs. They have a content of rock fragments in the subsoil that ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-silty, mixed Andeptic Cryoboralfs and sandy-skeletal, mixed Andic Cryochrepts. The Andeptic Cryoboralfs are in depressions. They formed in lacustrine silts and have low strength. The Andic Cryochrepts are on kames and terraces. They have coarse textured substrata and their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of

the subsoil is brown very gravelly silt loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly silt loam to.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by frost pockets in low areas. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26A-8 Andeptic Cryoboralfs, silty till substratum, calcareous, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed mostly in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, lodgepole pine, western larch and western white pine. Western redcedar, Engelmann spruce, subalpine fir and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat

type. However, grand fir/queencup beadlily and western redcedar/queencup beadlily are major habitat types in some low elevation valleys. These habitat types occupy about 80 percent of the map unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are on kames or terraces. Douglas-fir/pinegrass and subalpine fir/beargrass are on knolls and ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 7 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a content of rock fragments in the subsoil that ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Andeptic Cryoboralfs. They have a content of rock fragment in the subsoil that ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges. The dissimilar soils are sandy-skeletal, mixed Andic Cryochrepts and loamy-skeletal, mixed Lithic Cryochrepts. The Andic Cryochrepts are on terraces or kames. They have coarse textured substrata. The Lithic Cryochrepts are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Both dissimilar soils have a productivity for timber lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly silt loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly silt loam.

Management

Timber

The potential annual production is high. Although the

terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26A-9 Andeptic Cryoboralfs, silty till substratum, calcareous, steep

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, lodgepole pine, western larch and western white pine. Western redcedar, Engelmann spruce, subalpine fir and grand fir are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is usually the major habitat type. However, grand fir/queencup beadlily and western redcedar/queencup beadlily are major habitat types in some low elevation valleys. These habitat types occupy about 80 percent of the map unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and subalpine fir/beargrass are on knolls and ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 7 to 12 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. The content of rock fragments in their subsoil ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Andeptic Cryoboralfs. The content of rock fragments in their subsoil ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of this unit. The Rock outcrop is on ridges. The dissimilar soils are loamy-skeletal, mixed Lithic Cryochrepts. The Lithic Cryochrepts are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly silt loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly silt loam.

Management

Timber

The potential annual production is high. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire

lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is high.

26G-7 Typic Eutroboralfs, silty till substratum, rolling

This map unit is on moraines. Elevation ranges from 3,000 to 4,500 feet. The average annual precipitation is 18 to 30 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients from 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of Douglas-fir, grand fir, western larch and lodgepole pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/pinegrass is a similar habitat type. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on kames and terraces. Their productivity for timber is higher than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 2 to 7 inches thick. The surface layers formed in thin layers of loess that have been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Typic Eutroboralfs. They have an accumulation of clay in the subsoil. The content of rock fragments in their subsoil ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Typic Eutroboralfs or fine-loamy, mixed, frigid Typic Eutrochrepts. They have an accumulation of clay in the subsoil. The content of rock fragment in their subsoil ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-silty, mixed Typic Eutroboralfs and sandy-

skeletal, mixed, frigid Typic Eutrochrepts. The Typic Eutroboralfs are in basins and depressions. They formed in lacustrine silts and have low strength. The Typic Eutrochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Typic Eutroboralfs are dark yellowish brown silt loam in the upper 4 inches of the surface layer. They are pale brown gravelly silt loam in the lower 18 inches thick of the surface layer. The upper part of the subsoil is yellowish brown very gravelly silt loam about 18 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown extremely gravelly silt loam.

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration. Regeneration of the forest is limited by frost pockets in low areas and plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface. The material exposed in cutbanks during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is high.

26G-8 Typic Eutroboralfs, silty till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 4,500 feet. The average annual precipitation is 18 to 30 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, grand fir, western larch and lodgepole pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/pinegrass and Douglas-fir/dwarf huckleberry are similar habitat types. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on terraces and kames. Their productivity for timber is higher than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 2 to 7 inches thick. The surface layers formed in thin layers of loess that has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Typic Eutroboralfs. They have an accumulation of clay in the subsoil. The content of rock fragments in their subsoil ranges 35 to 50 percent. Similar soils are fine-loamy, mixed Typic Eutroboralfs or fine-loamy, mixed, frigid Typic Eutrochrepts. They have no accumulation of clay in the subsoil. The content of rock fragments in their subsoil ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges. The dissimilar soils are sandy-skeletal, mixed, frigid Typic Eutrochrepts and loamy-skeletal, mixed, frigid Lithic Eutrochrepts. The Typic Eutrochrepts are on kames and terraces. They have coarse textured substrata. The Lithic Eutrochrepts are on knolls and ridges. They have a soil depth of 4 to 20 inches over bedrock. Both soils have a productivity for timber lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Typic Eutroboralfs are dark yellowish brown silt loam in the upper 4 inches of the surface layer. They are pale brown gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is yellowish brown very gravelly silt loam about 18 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown extremely gravelly silt loam.

Management

Timber

The potential annual production is moderate. The terrain is well suited to the operation of tractors. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration. Regeneration of the forest is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26I-7 Typic Eutroboralfs, clayey till substratum, rolling

This map unit is on moraines. Elevation ranges from 4,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The soils formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of Douglas-fir, ponderosa pine, western larch, and lodgepole pine. Subalpine fir and spruce are included on northerly aspects and moist areas. The forest understory is dominated by low shrubs and pinegrass.

Habitat Types

The major habitat type is Douglas-fir/snowberry. Douglas-fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/queencup beadlily and subalpine fir/twinflower are on alluvial fans. Their productivity for timber is higher than that of the major habitat types. Wet meadows are also in depressions.

Geology

These soils are underlain by calcareous, clayey, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured surface layers. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are fine, mixed Typic Eutroboralfs. The content of rock fragments in their subsoil range from 15 to 35 percent. Similar soils are clayey-skeletal, mixed Typic Eutroboralfs. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are Borosaprists and Fluvents. The Borosaprists support wet meadows. They formed in organic deposits and are poorly drained. The Fluvents are on alluvial fans. They have a fluctuating water table. Their productivity for timber is higher than that of the dominant soils.

Representative Profile of the Soils

The fine, mixed Typic Eutroboralfs have a surface layer of reddish brown gravelly silt loam about 9 inches thick. The upper part of the subsoil is dark brown gravelly clay loam about 13 inches thick. The lower part to a depth of 60 inches or more is calcareous dark yellowish brown gravelly clay loam .

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration.

Regeneration of the forest is limited by frost pockets in low areas and plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a severe hazard of erosion. Sediment delivery efficiency is moderate.

26I-8 Typic Eutroboralfs, clayey till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 4,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, ponderosa pine, western larch, and lodgepole pine. Subalpine fir and spruce are included on northerly aspects, in moist areas, and at higher elevations. The forest understory is dominated by low shrubs and pinegrass.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/twinflower is similar. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Subalpine fir/queencup beadlily and subalpine fir/twinflower are on alluvial fans. Their productivity for timber is higher.

Geology

These soils are underlain by calcareous, clayey, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured surface layers.

Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are fine, mixed Typic Eutroboralfs. The content of rock fragments in their subsoils ranges from 15 to 35 percent. Similar soils are clayey-skeletal, mixed Typic Eutroboralfs. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges and knolls. The dissimilar soils are Fluvents and loamy-skeletal, mixed, frigid Lithic Eutrochrepts. The Fluvents are on alluvial fans. They have a fluctuating water table. Their productivity for timber is higher than that of the dominant soils. The Lithic Eutrochrepts are on ridges and knolls. They have a soil depth of 4 to 20 inches over bedrock. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The fine, mixed Typic Eutroboralfs have a surface layer of reddish brown gravelly silt loam about 9 inches thick. The upper part of the subsoil is dark brown gravelly clay loam about 13 inches thick. The lower part subsoil to depth of 60 inches or more is calcareous dark yellowish brown gravelly clay loam .

Management

Timber

The potential annual production is moderate. The terrain is well suited to the operation of tractors. Trees are susceptible to windthrow because lime in the substratum restricts root penetration. Regeneration of the forest is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a severe hazard of erosion. Sediment delivery efficiency is moderate.

26J-7 Andeptic Cryoboralfs, sandy till substratum, rolling

This map unit is on moraines. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of subalpine fir, lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is similar. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on kames and terraces. Their productivity for timber is lower than that of the major habitat types. Wet meadows are in depressions.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-silty, mixed Andeptic Cryoboralfs, sandy-skeletal, mixed Andic Cryochrepts, and Borosaprists. The Andeptic Cryoboralfs are in depressions. They formed in lacustrine silts and have low strength. The Andic Cryochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that of the dominant soils.

The Borosaprists are in wet meadows. They formed in organic deposits.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. The soil does not normally dry out enough to support tractors without severely compacting the surface. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by frost pockets in low areas.

Roads

Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26J-8 Andeptic Cryoboralfs, sandy till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir,

lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are on kames and terraces. Douglas-fir/pinegrass and subalpine fir/beargrass are on ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers 4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are sandy-skeletal, mixed Andic Cryochrepts and loamy-skeletal, mixed Lithic Cryochrepts. The Andic Cryochrepts are on terraces or kames. They have coarse textured substrata. The Lithic Cryochrepts are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Both soils have a productivity for timber lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface. The upper part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors

are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. The soil does not normally dry out enough to support tractors without severe compaction until summer. Tractor operation during the spring should be carefully managed to minimize the area affected.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26J-9 Andeptic Cryoboralfs, sandy till substratum, steep

This map unit is on glaciated mountain slopes. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and subalpine fir/beargrass are on ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured, loess surface layers

4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges. The dissimilar soils are loamy-skeletal, mixed Lithic Cryochrepts. They are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is high.

26G-7 Typic Eutroboralfs, silty till substratum, rolling

This map unit is on moraines. Elevation ranges from 3,000 to 4,500 feet. The average annual precipitation is 18 to 30 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients from 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of Douglas-fir, grand fir, western larch and lodgepole pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/pinegrass is a similar habitat type. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on included kames and terraces. Their productivity for timber is higher than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, brittle glacial till.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 7 inches thick. The surface layer formed in thin layers of loess that has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Typic Eutroboralfs. They have an accumulation of clay in the subsoil. The content of rock fragments in their subsoil ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Typic Eutroboralfs or fine-loamy, mixed, frigid Typic Eutrochrepts. The Typic Eutroboralfs have no accumulation of clay in the subsoil. The content of Rock fragments in their subsoil ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-silty, mixed Typic Eutroboralfs and sandy-skeletal, mixed, frigid Typic Eutrochrepts. The Typic Eutroboralfs are in basins and depressions. They formed in lacustrine silts and have low strength. The Typic Eutrochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Typic Eutroboralfs are dark yellowish brown silt loam in the upper 4 inches of the

surface layer. They are pale brown gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is yellowish brown very gravelly silt loam about 18 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown extremely gravelly silt loam.

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration. Regeneration of the forest is limited by frost pockets in low areas and plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction is difficult to revegetate because of moisture stress. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26G-8 Typic Eutroboralfs, silty till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 4,500 feet. The average annual precipitation is 18 to 30 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, grand fir, western larch and lodgepole pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/pinegrass and Douglas-fir/dwarf huckleberry are similar habitat types. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on terraces and kames. Their productivity for timber is higher than that of the major habitat types.

Geology

These soils are underlain by calcareous, silty, dense, brittle glacial till.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 7 inches thick. The surface layer formed in thin layers of loess that has been influenced by volcanic ash. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Typic Eutroboralfs. They have an accumulation of clay in the subsoil. The content of rock fragment in their subsoil ranges from 35 to 50 percent. Similar soils are fine-loamy, mixed Typic Eutroboralfs or fine-loamy, mixed, frigid Typic Eutrochrepts. They have no accumulation of clay in the subsoil. The content of rock fragments ranges from 15 to 35 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is also on ridges. The dissimilar soils are sandy-skeletal, mixed, frigid Typic Eutrochrepts and loamy-skeletal, mixed, frigid Lithic Eutrochrepts. The Typic Eutrochrepts are on kames and terraces. They have coarse textured substrata. The Lithic Eutrochrepts are on knolls and ridges. They have a soil depth of 4 to 20 inches over bedrock. Both soils have a productivity for timber lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Typic Eutroboralfs are dark yellowish brown silt loam in the upper 4 inches of the surface layer. They are pale brown gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is yellowish brown very gravelly silt loam about 18 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown extremely gravelly silt loam.

Management

Timber

The potential annual production is moderate. The terrain is well suited to the operation of tractors. Trees are susceptible to windthrow because lime in the lower subsoil restricts root penetration. Regeneration of the forest is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26I-7 Typic Eutroboralfs, clayey till substratum, rolling

This map unit is on moraines. Elevation ranges from 4,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The soils formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of Douglas-fir, ponderosa pine, western larch, and lodgepole pine. Subalpine fir and spruce are included on slopes with northerly aspects and in moist areas. The forest understory is dominated by low shrubs and pinegrass.

Habitat Types

The major habitat type is Douglas-fir/snowberry. Douglas-fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/queencup beadlily and subalpine fir/twinflower are on alluvial fans. Their productivity for timber is higher than that of the major habitat types. Wet meadows are in depressions.

Geology

These soils are underlain by calcareous, clayey, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured surface layers. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are fine, mixed Typic Eutroboralfs. The content of Rock fragments in their subsoil ranges from 15 to 35 percent. Similar soils are clayey-skeletal, mixed Typic Eutroboralfs. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are Borosaprists and Fluvents. The Borosaprists support wet meadows. They formed in organic deposits and are poorly drained. The Fluvents are on alluvial fans. They have a fluctuating water table. Their productivity for timber is higher than that of the dominant soils.

Representative Profile of the Soils

The fine, mixed Typic Eutroboralfs have a surface layer of reddish brown gravelly silt loam about 9 inches thick. The upper part of the subsoil is dark brown gravelly clay loam about 13 inches thick. The lower part to a depth of 60 inches or more is calcareous dark yellowish brown gravelly clay loam.

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts. Trees are susceptible to windthrow because the calcareous substratum restricts root penetration. Regeneration of the forest is limited by frost pockets in low areas and plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a severe hazard of erosion. Sediment delivery efficiency is moderate.

Logging skid trails and firelines have moderate erosion hazards. The material exposed by road construction has severe erosion hazards. Sediment delivery efficiency is moderate.

26I-8 Typic Eutroboralfs, clayey till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 4,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of Douglas-fir, ponderosa pine, western larch, and lodgepole pine. Subalpine fir and spruce are included on slopes with northerly aspects, in moist areas, and at higher elevations. The forest understory is dominated by low shrubs and pinegrass.

Habitat Types

Douglas-fir/snowberry is the major habitat type. Douglas-fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Subalpine fir/queencup beadlily and subalpine fir/twinflower are on alluvial fans. Their productivity for timber is higher than that of the major habitat types.

Geology

These soils are underlain by calcareous, clayey, dense, brittle glacial till.

Characteristics of the Soils

These soils have medium textured surface layers. Subsoils contain 15 to 50 percent rounded rock fragments. The lower soil layers are calcareous and contain 15 to 35 percent lime.

Map Unit Composition

The dominant soils are fine, mixed Typic Eutroboralfs.

The content of Rock fragments in their subsoil ranges from 15 to 35 percent. Similar soils are clayey-skeletal, mixed Typic Eutroboralfs. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges and knolls. The dissimilar soils are Fluvents and loamy-skeletal, mixed, frigid Lithic Eutrochrepts. The Fluvents are on alluvial fans. They have a fluctuating water table. Their productivity for timber is higher than that of the dominant soils. The Lithic Eutrochrepts are on ridges and knolls. They have a soil depth of 4 to 20 inches over bedrock. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The fine, mixed Typic Eutroboralfs have a surface layer of reddish brown gravelly silt loam about 9 inches thick. The upper part of the subsoil is dark brown gravelly clay loam about 13 inches thick. The lower part to a depth of 60 inches or more is calcareous dark yellowish brown gravelly clay loam.

Management

Timber

The potential annual production is moderate. The terrain is well suited to the operation of tractors. Regeneration of the forest is limited by plant competition. Pinegrass competes vigorously with tree seedlings in open areas. Trees are susceptible to windthrow because the calcareous substratum restricts root penetration.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep and is difficult to revegetate because of moisture stress. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a severe hazard of erosion. Sediment delivery efficiency is moderate.

26J-7 Andeptic Cryoboralfs, sandy till substratum, rolling

This map unit is on moraines. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Moraines are rolling glacial till deposits. They have a deranged drainage pattern.

Vegetation

The vegetation is a mixed forest of subalpine fir, lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir/dwarf huckleberry and Douglas-fir/dwarf huckleberry are on kames and terraces. Their productivity for timber is lower than that of the major habitat types. Wet meadows are in depressions.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-silty, mixed Andeptic Cryoboralfs, sandy-skeletal, mixed Andic Cryochrepts, and Borosaprists. The Andeptic Cryoboralfs are in depressions. They formed in lacustrine silts and have low strength. The Andic Cryochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that of the dominant soils. The Borosaprists are in wet meadows. They formed in organic deposits.

Representative Profile of the Soils

Andeptic Cryoboralfs, loamy-skeletal, mixed are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface layer. The upper

part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered. Regeneration of the forest is limited by frost pockets in low areas.

Roads

Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26J-8 Andeptic Cryoboralfs, sandy till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are on kames and terraces. Douglas-fir/

pinegrass and subalpine fir/beargrass are on ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are sandy-skeletal, mixed Andic Cryochrepts and loamy-skeletal, mixed Lithic cryochrepts. The Andic Cryochrepts are on terraces or kames. They have coarse textured substrata. The Lithic Cryochrepts are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Both soils have a productivity for timber lower than that of the dominant soils.

Representative Profile of the Soils

The loamy-skeletal, mixed Andeptic Cryoboralfs are dark yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts.

Roads

Material exposed in cutbanks during road construction

tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26J-9 Andeptic Cryoboralfs, sandy till substratum, steep

This map unit is on glaciated mountain slopes. Elevation ranges from 3,100 to 5,500 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and drainages are widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, lodgepole pine, Douglas-fir, and western larch. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Subalpine fir/twinflower is a similar habitat type. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and subalpine fir/beargrass are on ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by calcareous, sandy, dense, brittle glacial till.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 4 to 10 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 60 percent rounded rock fragments. The lower soil layers are calcareous.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andeptic Cryoboralfs. They have a surface layer of loess 7 to 10

inches thick. Similar soils are loamy-skeletal, mixed Typic Cryoboralfs. They have a surface layer of loess 4 to 7 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on ridges. The dissimilar soils are loamy-skeletal, mixed Lithic Cryochrepts. The Lithic Cryochrepts are on ridges. They have a soil depth of 4 to 20 inches over bedrock. Their productivity for timber is lower than that for the dominant soils.

Representative Profile of the Soils

Andeptic Cryoboralfs, loamy-skeletal, mixed have a dark yellowish brown silt loam upper surface layer about 11 inches thick. They are pale brown very gravelly sandy loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly sandy clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is calcareous brown very gravelly sandy loam.

Management

Timber

The potential annual production is high. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is high.

26L-7 Glossic Cryoboralfs, till substratum, rolling

This map unit is on moraines. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 30 to 45 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Moraines are rolling deposits of till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of western larch, Douglas-fir, lodgepole pine, western white pine, subalpine fir, grand fir and spruce. Western redcedar is included in places. The forest understory is dominated by forbs and shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Grand fir/queencup beadlily and western redcedar/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are on kames and terraces. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by silty, dense, brittle, glacial till derived from well weathered metasedimentary rocks or soft sedimentary rocks. The glacial till has yellow, orange, buff, brown, pink or red colors.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 12 inches thick. The surface layers formed in thin deposits of loess that has been influenced by volcanic ash. The subsoil contains 15 to 50 percent rounded rock fragments.

Map Unit Composition

The dominant soils are fine-loamy, mixed Glossic Cryoboralfs. They have a surface layer of loess 2 to 7 inches thick. The content of rock fragments in their subsoil ranges from 15 to 35 percent. Similar soils are have a surface layer of loess 7 to 12 inches thick or 35 to 50 percent subsoil rock fragments. They are fine-loamy, mixed Andeptic Cryoboralfs or loamy-skeletal, mixed Glossic Cryoboralfs. The dominant and similar soils make up about 90 percent of the map unit.

Dissimilar soils make up about 10 percent of the unit. They are sandy-skeletal, mixed Typic Cryochrepts. The Typic Cryochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that for the dominant soils.

Representative Profile of the Soils

The fine-loamy, mixed Glossic Cryoboralfs are brown silt loam in the upper 6 inches of the surface layer. They are pale brown gravelly silt loam in the lower 11 inches of the surface layer. The upper part of the subsoil is dark yellowish brown and yellowish brown gravelly silty clay loam about 17 inches thick. The lower part to a depth of 60

inches or more is calcareous yellowish brown gravelly silt loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered.

Roads

If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26L-8 Glossic Cryoboralfs, till substratum, hilly

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 30 to 45 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of western larch, Douglas-fir, lodgepole pine, western white pine, subalpine fir, grand fir and spruce. Western redcedar is included in places. The forest understory is dominated by forbs and shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Grand fir/queencup beadlily and western redcedar/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/dwarf huckleberry and subalpine fir/dwarf

huckleberry are on kames and terraces. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by silty, dense, brittle, glacial till derived from well weathered metasedimentary rocks or soft sedimentary rocks. The glacial till has yellow, orange, buff, brown, pink or red colors.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 12 inches thick. The surface layer formed in thin deposits of loess that has been influenced by volcanic ash. The subsoil contains 15 to 50 percent rounded rock fragments.

Map Unit Composition

The dominant soils are fine-loamy, mixed Glossic Cryoboralfs. They have a surface layer of loess 2 to 7 inches thick. The content of rock fragments in their subsoil ranges from 15 to 35 percent. Similar soils are fine-loamy, mixed Andeptic Cryoboralfs or loamy-skeletal, mixed Glossic Cryoboralfs. They have a surface layer of loess 7 to 12 inches thick. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 90 percent of the map unit.

Dissimilar soils make up about 10 percent of the unit. They are sandy-skeletal, mixed Typic Cryochrepts. The Typic Cryochrepts are on kames and terraces. They have coarse textured substrata. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The fine-loamy, mixed Glossic Cryoboralfs are brown silt loam in the upper 6 inches of the surface layer. They are pale brown gravelly silt loam in the lower 11 inches of the surface layer. The upper part of the subsoil is dark yellowish brown and yellowish brown gravelly silty clay loam about 17 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown gravelly silt loam.

Management

Timber

The potential annual production is high. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can become compacted or be displaced. Tractor operation in spring, when the soil is wet and has low strength, should be carefully managed to minimize compaction and the formation of ruts.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is moderate.

26L-9 Glossic Cryoboralfs, till substratum, steep

This map unit is on glaciated mountain slopes. Elevation ranges from 3,000 to 5,000 feet. The average annual precipitation is 30 to 45 inches. The vegetation is moist, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 40 to 60 percent. Glaciated mountain slopes are mantled with glacial till. The drainage pattern is dendritic and widely spaced.

Vegetation

The vegetation is a mixed forest of western larch, Douglas-fir, lodgepole pine, western white pine, subalpine fir, grand fir and spruce. Western redcedar is included in places. The forest understory is dominated by forbs and shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type. Grand fir/queencup beadlily and western redcedar/queencup beadlily are similar habitat types in low elevation delineations. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/pinegrass and subalpine fir/beargrass are on ridges. Their productivity for timber is lower than that of the major habitat types.

Geology

These soils are underlain by silty, dense, brittle, glacial till derived from well weathered metasedimentary rocks or soft sedimentary rocks. The glacial till has yellow, orange, buff, brown, pink or red colors.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 12 inches thick. The surface layer formed in thin deposits of loess that has been influenced by volcanic ash.

The subsoils contain 15 to 50 percent rounded rock fragments.

Map Unit Composition

The dominant soils are fine-loamy, mixed Glossic Cryoboralfs. They have a surface layer of loess 2 to 7 inches thick. The content of rock fragments in their subsoil ranges from 15 to 35 percent. Similar soils are fine-loamy, mixed Andeptic Cryoboralfs or loamy-skeletal, mixed Glossic Cryoboralfs. They have a surface layer of loess 7 to 12 inches thick. The content of rock fragments in their subsoil ranges from 35 to 50 percent. The dominant and similar soils make up about 90 percent of the map unit.

Dissimilar soils make up about 10 percent of the unit. loamy-skeletal, mixed Typic Cryochrepts. The Typic Cryochrepts are on ridges. The content of rock fragments in their subsoil ranges from 50 to 80 percent. Their productivity for timber is lower than that of the dominant soils.

Representative Profile of the Soils

The fine-loamy, mixed Glossic Cryoboralfs are brown silt loam in the upper 6 inches of the surface layer. They are pale brown gravelly silt loam in the lower 11 inches of the surface layer. The upper part of the subsoil is dark yellowish brown and yellowish brown gravelly silty clay loam about 17 inches thick. The lower part to a depth of 60 inches or more is calcareous yellowish brown gravelly silt loam.

Management

Timber

The potential annual production is high. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. If unsurfaced roads are traveled when the soils are wet, the formation of ruts is a hazard.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is high.

27-7 Dystric Eutrochrepts, till substratum

This map unit is on kames and kettles or terraces. Elevation ranges from 3,000 to 4,100 feet. In some delineations elevation is at 5,200 feet. The average annual

precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 10 to 20 percent. Kames and kettles are a complex pattern of knolls and depressions. The drainage pattern is deranged. There are bogs and marshes in kettles. Terraces have a dendritic pattern of widely spaced drainages.

Vegetation

The vegetation is a mixed forest of Douglas-fir, subalpine fir, lodgepole pine, western larch and ponderosa pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are the major habitat types. These habitat types occupy about 90 percent of the unit.

Dissimilar habitat types and community types are in about 10 percent of the unit. Subalpine fir/twinflower is in shallow depressions. Their productivity for timber is higher than that of the major habitat types. Wet meadows are in depressions.

Geology

These soils are underlain by cobbly, sandy, glacial till. The till has been sorted by glacial meltwater, but is not stratified.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 10 inches thick. The surface layer formed in loess that has been influenced by volcanic ash. Subsoils and substrata contain 50 to 80 percent rounded rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed, frigid Dystric Eutrochrepts. They have a surface layer of loess 2 to 7 inches thick. Similar soils are loamy-skeletal, mixed, frigid Andic Dystric Eutrochrepts. They have a surface layer of loess 7 to 10 inches thick. The dominant and similar soils make up about 90 percent of the map unit.

Dissimilar soils make up about 10 percent of the unit. They are fine-loamy, mixed, frigid Dystric Eutrochrepts and Borosaprists. The Dystric Eutrochrepts formed in lacustrine deposits in shallow depressions. The content of rock fragments in their subsoil ranges from 0 to 35 percent. Their productivity for timber is higher than that of the dominant soils. The Borosaprists are in depressions and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed, frigid Dystric Eutrochrepts have a surface layer of brown very gravelly silt loam about 6 inches thick. The upper part of the subsoil is light yellowish brown extremely cobbly sandy loam about 9 inches thick. The lower part is light olive brown extremely cobbly sandy loam about 13 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown extremely cobbly loamy sand.

Management

Timber

The potential annual production is moderate. Productivity on the site is highly dependent on the loess surface layer. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the loess surface layer can become compacted or be displaced or it can be mixed with subsoil material. The soil has a low water-holding capacity. Regeneration of the forest is limited by droughtiness.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained. Material exposed in cutbanks during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is low.

27-8 Dystric Eutrochrepts, till substratum, steep

This map unit is on kames and kettles or terraces. Elevation ranges from 3,000 to 4,100 feet. In some delineations elevation is at 5,200 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Kames and kettles are a complex pattern of knolls and depressions. The drainage pattern is deranged. There are bogs and marshes in kettles. Terraces have a dendritic pattern of widely spaced drainages.

Vegetation

The vegetation is a mixed forest of Douglas-fir,

subalpine fir, lodgepole pine, western larch and ponderosa pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are the major habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. Subalpine fir and spruce series habitat types that support wet forest are in depressions. Wet meadows are in undrained depressions.

Geology

These soils are underlain by cobbly, sandy, glacial till. The till has been sorted by glacial meltwater, but is not stratified.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 10 inches thick. The surface layer formed in loess that has been influenced by volcanic ash. Subsoils and substrata contain 50 to 80 percent rounded rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed, frigid Dystric Eutrochrepts. They have a surface layer of loess 2 to 7 inches thick. Similar soils are loamy-skeletal, mixed, frigid Andic Dystric Eutrochrepts. They have a surface layer of loess 7 to 10 inches thick. The dominant and similar soils make up about 80 percent of the map unit.

Dissimilar soils make up about 20 percent of the unit. They are fine-loamy, mixed, frigid Dystric Eutrochrepts and borosaprists. The Dystric Eutrochrepts formed in lacustrine deposits in shallow depressions. The content of rock fragments in their subsoil ranges from 0 to 35 percent. Their productivity for timber is higher than that of the dominant soils. Borosaprists are in depressions and support wet meadows.

Representative Profile of the Soils

The loamy-skeletal, mixed, frigid Dystric Eutrochrepts have a surface layer of brown very gravelly silt loam about 6 inches thick. The upper part of the subsoil is light yellowish brown extremely cobbly sandy loam about 9 inches thick. The lower part is light olive brown extremely cobbly sandy loam about 13 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown extremely cobbly loamy sand.

Management

Timber

The potential annual production is moderate.

Productivity on the site is highly dependent on the loess surface layer. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the loess surface layer can become compacted or be displaced or it can be mixed with subsoil material. The soil has a low water-holding capacity. Regeneration of the forest is limited by droughtiness.

Roads

Material exposed in cutbanks during road construction tends to ravel if the slopes are steep and is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is low.

28-7 Dystric Eutrochrepts, outwash substratum

This map unit is on terraces. Elevation ranges from 3,000 to 4,100 feet. In some delineations elevation is at 4,600 feet. The average annual precipitation is 20 to 40 inches. The vegetation is dry, mixed forest. The lower soil layers formed in glacial outwash.

Landform

The dominant slopes have gradients of 0 to 20 percent. Terrace surfaces have a dendritic pattern of widely spaced drainages.

Vegetation

The vegetation is a mixed forest of Douglas-fir, ponderosa pine, subalpine fir and lodgepole pine. The forest understory is dominated by low shrubs.

Habitat Types

Douglas-fir/dwarf huckleberry and subalpine fir/dwarf huckleberry are major habitat types. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types and community types are in about 15 percent of the unit. Subalpine fir/queencup beadlily is in depressions. Their productivity for timber is higher than that of the major habitat types. Wet meadows are in depressions.

Geology

These soils are underlain by stratified glacial outwash deposits of sand and gravel.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 7 inches thick. The surface layer formed in loess that has been influenced by volcanic ash. Subsoils contain 35 to 80 percent rounded rock fragments.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed, frigid Dystric Eutrochrepts. They have thick subsoils. Similar soils are sandy-skeletal, mixed, frigid Dystric Eutrochrepts. They have thin subsoils. The dominant and similar soils make up about 85 percent of the map unit.

Dissimilar soils make up about 15 percent of the unit. They are Borosaprists and Aquepts. The Borosaprists are in depressions. They formed in organic deposits and are poorly drained. The Aquepts are also in depressions. They formed in lacustrine deposits, have mottled subsoils, are wet and have low strength.

Representative Profile of the Soils

The loamy-skeletal, mixed, frigid Dystric Eutrochrepts have a surface layer of brown silt loam about 6 inches thick. The subsoil is light yellowish brown extremely gravelly loam about 22 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy coarse sand.

Management

Timber

The potential annual production is moderate. Productivity on the site is highly dependent on the loess surface layer. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the loess surface layer can become compacted or be displaced or it can be mixed with subsoil material. The soil has a low water-holding capacity. Regeneration of the forest is limited by droughtiness. Trees are susceptible to windthrow because the coarse textured substrata restricts root penetration.

Roads

Tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface. Material exposed in cutbanks during road construction is difficult to revegetate because of moisture stress.

Watershed

Erosion is a moderate hazard along skid trails and fire lines and in areas where soil material has been exposed by road construction. Sediment delivery efficiency is low.

31 Boralfs-Ochrepts complex, landslide deposits

This map unit is on landslide deposits. Elevation ranges from 3,100 to 5,000 feet. The average annual precipitation is 30 to 50 inches. The vegetation is moist, mixed forest. The soils formed in landslide deposits derived from metasedimentary rocks.

Landform

Landslide deposits have a hummocky surface with dominant slope gradients of 10 to 30 percent. The drainage pattern is deranged. There are seeps and springs below breaks in slope gradients and sag ponds where drainages have been blocked by landslides.

Vegetation

The vegetation is a mixed forest of subalpine fir, Engelmann spruce, lodgepole pine and western larch. Western redcedar, grand fir and western white pine are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type on benches. In some areas similar habitat types are grand fir/queencup beadlily and western redcedar/queencup beadlily. These habitat types occupy about 50 percent of the unit.

Subalpine fir/beargrass is on southerly facing escarpments and subalpine fir/Menziesia is on northerly facing escarpments. These habitat types occupy about 30 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Subalpine fir and spruce series habitat types are on wet soils around seeps and springs. They support wet forest.

Geology

These soils are underlain by landslide deposits derived from layered, dipping metasedimentary rocks. These deposits are a series of large block glides that have been modified by small scale rotational slumps and earthflows.

Characteristics of the Soils

These soils have medium and moderately fine textured surface layers. Soil properties vary with topography. Soils on benches have subsoil clay accumulations. Soils on escarpments do not have subsoil clay accumulations.

Map Unit Composition

The dominant soils are Boralfs and Ochrepts. The Boralfs are on benches. The Ochrepts are on

escarpments. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent of the unit. The Rock outcrop is on escarpments. The dissimilar soils are Aquepts. The Aquepts are around seeps and springs. They have mottled subsoils, are wet, and have low strength.

Representative Profile of the Soils

The dominant Boralfs have a surface layer of brown silt loam in the upper 8 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 9 inches of the surface layer. The subsoil is brown very gravelly clay loam about 14 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly loam.

The dominant Ochrepts have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part to depths of 60 inches or more is brown extremely cobbly loamy sand.

Management

Timber

The potential annual production is high. Although the terrain is suited to the operation of tractors, broken slopes limit tractor operation on this site. Likewise, if tractors are operated on the benches at this site, productivity can be lowered because the surface layer can become compacted. The soil does not dry out enough to support tractors without compacting the surface layer. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Landslides can damage roads in places. Suitability for road construction should be evaluated on site.

Watershed

Erosion hazard should be evaluated on site. Sediment delivery efficiency is low.

32 Boralfs-Ochrepts complex, landslide deposits, steep

This map unit is on landslide deposits. Elevation ranges from 4,000 to 6,000 feet. The average annual precipitation is 30 to 60 inches. The vegetation is moist, mixed forest.

The soils formed in landslide deposits derived from metasedimentary rocks.

Landform

These landslide deposits are a complex of benches and escarpments. The benches have dominant slope gradients of 15 to 35 percent and the escarpments have dominant slope gradients of 35 to 60 percent. The drainage pattern is deranged. There are seeps and springs below breaks in slope gradients and sag ponds where drainages have been blocked by landslides.

Vegetation

The vegetation is a mixed forest of subalpine fir, Engelmann spruce, lodgepole pine and western larch. Western redcedar, grand fir and western white pine are included in places. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/queencup beadlily is the major habitat type on benches. In some areas similar habitat types are grand fir/queencup beadlily and western redcedar/queencup beadlily. These habitat types occupy about 50 percent of the unit.

Subalpine fir/beargrass is on southerly facing escarpments and subalpine fir/Menziesia is on northerly facing escarpments. These habitat types occupy about 30 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Subalpine fir and spruce series habitat types are on wet soils around seeps and springs. They support wet forest.

Geology

These soils are underlain by landslide deposits derived from layered, dipping metasedimentary rocks. These deposits are a series of large block glides that have been modified by small scale rotational slumps and earthflows.

Characteristics of the Soils

These soils have medium and moderately fine textured surface layers. Soil properties vary with topography. Soils on benches have subsoil clay accumulations. Soils on escarpments do not have subsoil clay accumulations.

Map Unit Composition

The dominant soils are Boralfs and Ochrepts. The Boralfs are on benches. The Ochrepts are on escarpments. The dominant and similar soils make up about 85 percent of the map unit.

The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Rock outcrop and dissimilar soils make up about 15 percent. The Rock outcrop is on escarpments. The Aquepts are around seeps and springs. They have mottled subsoils, are wet, and have low strength.

Representative Profile of the Soils

The dominant Boralfs are brown silt loam in the upper 8 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 9 inches of the surface layer. The subsoil is brown very gravelly clay loam about 14 inches thick. The substratum to a depth of 60 inches or more is brown very gravelly loam to depths of 60 inches or more.

The dominant Ochrepts have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part to a depth of 60 inches or more is brown extremely cobbly loamy sand.

Management

Timber

The potential annual production is high. The slope limits the operation of tractors in some areas. A combination of tractor and cable logging systems helps to overcome the slope. If tractors are operated on the benches at this site, productivity can be lowered because the surface layer can become compacted. The soil does not dry out enough to support tractors without compacting the surface layer. Tractor operation should be carefully managed and confined to periods when the soil is frozen or snow covered.

Roads

Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep. Landslides can damage roads in places. Suitability for road construction should be evaluated on site.

Watershed

Erosion hazard should be evaluated on site. Sediment delivery efficiency is low. Management practices which disturb the soil can cause landslides and produce sediment. Slope stability should be evaluated on site.

54 Cirqueland

This map unit is in cirque basins. Elevation ranges from 5,500 to 7,500 feet. This unit is mostly barren, glacially scoured, hard metasedimentary bedrock. Fractures and depressions in the bedrock contain small areas of shallow soils. These soils support grass and shrubs with some scattered subalpine fir and whitebark pine. Dominant slopes have gradients of 10 to 30 percent.

This map unit has value as a watershed and for wildlife habitat. Some areas of this map unit are suitable for recreational activity.

55 Rock outcrop, glaciated mountain slopes

This map unit is on glaciated mountain slopes. Elevation ranges from 3,300 to 5,500 feet. The unit is mostly barren, glacially scoured, hard metasedimentary bedrock. Fractures in the bedrock contain small areas of shallow soils. These soils support grasses and shrubs with some scattered Douglas-fir, lodgepole pine and subalpine fir. Dominant slopes have gradients of 40 to 60 percent.

This map unit is not suited for most land uses.

57-8 Andic Cryochrepts, glaciated mountain ridges

This map unit is on glaciated mountain ridges. Elevation ranges from 4,000 to 7,500 feet. The average annual precipitation is 35 to 80 inches. The vegetation is lower subalpine forest. The lower soil layers formed mostly in materials derived from metasedimentary rocks. In some locations, however, the lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 20 to 40 percent. Glaciated mountain ridges have smooth, rounded convex ridgetops and lower slopes. There are almost no surface drainages.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch and western white pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/beargrass is the major habitat type on southerly aspects and subalpine fir/grouse whortleberry, pinegrass phase is the major habitat type on northerly aspects. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/queencup beadlily is in depressions and subalpine fir/Menziesia is on northerly aspects. Their productivity for timber is higher than that of the major habitat types.

Geology

This map unit is underlain by argillite, quartzite, siltite, and limestone of the Belt supergroup. Thin deposits of dense, brittle glacial till overlie the bedrock in some places.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 22 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 80 percent angular or rounded rock fragments. These soils are 20 to more than 60 inches deep over bedrock.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andic Cryochrepts. They have a surface layer of loess 7 to 14 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts or medial-skeletal Entic Cryandeps. They have a surface layer of loess 2 to 7 inches thick or a surface layer of loess 14 to 22 inches thick. The dominant and similar soils make up about 90 percent of the map unit.

Rock outcrop is a dissimilar inclusion on ridges and knolls and occupies as much as 10 percent of the unit.

Representative Profile of the Soils

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly silt loam and very gravelly silt layer about 12 inches thick. The subsoil is brown extremely gravelly silt loam to a depth of 32 inches over bedrock.

Management

Timber

The potential annual production is moderate. Although the terrain is well suited to the operation of tractors, if tractors are operated on the site, productivity can be lowered because the surface layer can be displaced or it can be mixed with subsoil material. Regeneration of the forest is limited by moisture stress on southerly aspects.

Roads

This map unit is suitable as a site for roads that are properly located, constructed, and maintained.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is low.

57-9 Andic Cryochrepts, glaciated mountain slopes

This map unit is on glaciated mountain slopes. Elevation ranges from 4,000 to 7,500 feet. The average annual precipitation is 35 to 80 inches. The vegetation is lower

subalpine forest. The lower soil layers formed mostly in material derived from metasedimentary rocks. In some locations, however, the lower soil layers have formed in glacial till.

Landform

The dominant slopes have gradients of 40 to 60 percent. In some areas the glaciated mountain slopes have thin deposits of glacial till. The drainage pattern is dendritic and is widely spaced.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir, lodgepole pine, western larch and western white pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir/beargrass is the major habitat type on southerly aspects and subalpine fir/grouse whortleberry is the major habitat type on northerly aspects. Subalpine fir/Menziesia is a similar habitat type on northerly aspects. These habitat types occupy about 85 percent of the unit.

Dissimilar habitat types are in about 15 percent of the unit. Subalpine fir/queencup beadlily is on concave slopes along drainages. Their productivity for timber is higher than that of the major habitat types. Douglas-fir/snowberry is on low elevation southerly aspects and supports dry, mixed forest.

Geology

This map unit is underlain by argillite, quartzite, siltite, and limestone of the Belt supergroup. Thin deposits of dense, brittle glacial till overlie the bedrock in some places.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 2 to 22 inches thick. The loess has been influenced by volcanic ash. Subsoils contain 35 to 80 percent angular or rounded rock fragments. These soils are 20 to more than 60 inches deep over bedrock.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andic Cryochrepts. They have a surface layer of loess 7 to 14 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts or medial-skeletal Entic Cryandeps, Entic Cryandeps. They have a surface layer of loess 2 to 7 inches thick or a surface layer of loess 14 to 22 inches thick. The dominant and similar soils make up about 90 percent of the map unit.

Rock outcrop is a dissimilar inclusion on ridges and knolls and occupies as much as 10 percent of the unit.

Representative Profile of the Soils

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly silt loam and very gravelly silt loam about 12 inches thick. The subsoil is brown extremely gravelly silt loam to a depth of 32 inches over bedrock.

Management

Timber

The potential annual production is moderate. Steep slopes limit the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by moisture stress on southerly aspects.

Roads

The material exposed in cutbanks during road construction tends to ravel if the slopes are steep.

Watershed

Erosion is a moderate hazard along skid trails and fire lines. The material exposed by road construction has a slight hazard of erosion. Sediment delivery efficiency is moderate.

72 Cirqueland-Entic Cryandeps complex, very steep

This map unit is on cirque headwalls and alpine ridges. Elevation ranges from 6,000 to 10,000 feet. The average annual precipitation is 60 to 100 inches. The vegetation is upper subalpine forest. The lower soil layers formed in loess that has been influenced by volcanic ash, and mixed with material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 60 to 90 percent. Cirque headwalls are the dominant landforms and are most often on northerly aspects. Alpine ridges are most often on southerly aspects. There is no surface drainage pattern.

Vegetation

The vegetation is an open-grown forest of whitebark pine and subalpine fir. Lodgepole pine and alpine larch are included in places. The forest understory is dominated by low shrubs and forbs.

Habitat Types

The major habitat types in forested areas is whitebark pine-subalpine fir. Subalpine fir/woodrush is a similar

habitat type in depressions. These habitat types occupy about 80 percent of the forested part of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Subalpine fir/beargrass and subalpine fir/grouse whortleberry are on southerly aspects. Their productivity for timber is higher than that of the major habitat types.

Geology

This map unit is underlain by argillite, quartzite, siltite, and limestone of the Belt supergroup.

Characteristics of the Soils

These soils have medium textured surface layers. The soil formed in loess mixed with rock fragments. The rock fragments are derived from the underlying bedrock. The loess has been influenced by volcanic ash. Subsoils contain 35 to 90 percent angular rock fragments. These soils are 20 to 60 inches deep over bedrock.

Map Unit Composition

The dominant soils are Cirqueland and medial-skeletal Entic Cryandeps. The Cirqueland occupies about 60 percent of the unit. The Entic Cryandeps are the major soil on alpine ridges and occupy about 40 percent of the unit.

The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Representative Profile of the Soils

The medial-skeletal Entic Cryandeps are black gravelly silt loam in the upper 4 inches of the surface layer. They are brown gravelly silt loam in the lower 3 inches of the surface layer. The upper part of the subsoil is yellowish brown very gravelly silt loam and extremely gravelly silt loam about 13 inches thick. The lower part is yellowish brown and brownish yellow extremely gravelly silt loam to 40 inches over bedrock.

Management

Timber

This map unit contains only scattered stands of trees. It is poorly suited to woodland managed for timber.

Management.

Roads

The slope increases the quantity of material excavated during road construction. The hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. Large stones can roll from roadcuts

onto road surfaces causing a driving hazard. Material exposed during road construction is difficult to revegetate because of moisture stress. Avalanches can increase the cost of maintaining the roads.

Watershed

The material exposed by road construction has a slight hazard of erosion. Although slopes are very steep and eroded soil can travel relatively far to drainage channels, delineations of this map unit are usually too far from drainage channels for eroded soil to become sediment.

73 Andic Cryochrepts-Andeptic Cryoboralfs association, glacial trough walls

This map unit is on glacial trough walls. Elevation ranges from 3,500 to 6,000 feet. The average annual precipitation is 30 to 60 inches. The vegetation is lower subalpine forest on the upper slopes and moist, mixed forest on lower slopes. At the upper slope locations the lower soil layers formed in material derived from metasedimentary rocks. At the lower slope locations the lower soil layers formed in glacial till.

Landform

The dominant slopes have gradients of 60 to 90 percent. The glacial trough walls have straight slopes on the upper half and concave slopes on the lower half. The landform has many avalanche paths. The drainage pattern is parallel and contains closely spaced, weakly incised drainages.

Vegetation

The vegetation is a mixed forest of subalpine fir, Douglas-fir and lodgepole pine. Western larch is included on lower slopes. The forest understory is dominated by forbs and shrubs.

Habitat Types

The major habitat types are Subalpine fir/beargrass, Subalpine fir/Menziesia, and Subalpine fir/queencup beadlily. Subalpine fir/beargrass is the major habitat type on south facing upper slopes. Subalpine fir/Menziesia is the major habitat type on north facing upper slopes. These habitat types occupy about 45 percent of the unit.

Subalpine fir/queencup beadlily is the major habitat type on lower slopes. This habitat types occupies about 35 percent of the unit.

Dissimilar habitat types and community types are in about 20 percent of the unit. A shrub community containing aspen, Sitka alder, willow, yew, Menziesia and devil's club is in avalanche paths and drainages. Douglas-fir/snowberry is on low elevation southerly aspects and supports dry, mixed forest.

Geology

This map unit is underlain by argillite, siltite, quartzite, and limestone of the Belt supergroup. Thin deposits of dense, brittle glacial till overlie the bedrock on lower slopes.

Characteristics of the Soils

These soils have a medium textured surface layer of loess 4 to 14 inches thick. The loess has been influenced by volcanic ash. Soil properties vary with topographic position. Soils on lower slopes have a clay accumulation in the subsoil. The content of rounded rock fragments in the subsoil ranges from 35 to 50 percent. These soils have a depth of 60 inches or more. Soils on upper slopes do not have a clay accumulation in the subsoil. The content of angular rock fragments ranges from 35 to 80 percent. These soils have a depth or 20 to 60 inches over bedrock.

Map Unit Composition

The dominant soils are loamy-skeletal, mixed Andic Cryochrepts and loamy-skeletal, mixed Andeptic Cryoboralfs. The Andic Cryochrepts are on upper slopes and have a surface layer of loess 7 to 14 inches thick. Similar soils are loamy-skeletal, mixed Typic Cryochrepts. They have a surface layer of loess 4 to 7 inches thick. These soils make up about 45 percent of the map unit.

The Andeptic Cryoboralfs are on lower slopes. These soils make up about 35 percent of the map unit.

The components of this unit were not mapped separately because survey objectives did not require it.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is on upper slopes. The Aquepts are in avalanche paths and draws. They have mottled subsoils, are wet, and support shrub communities.

Representative Profile of the Soils

The loamy-skeletal, mixed Andic Cryochrepts have a surface layer of brown gravelly silt loam and very gravelly silt loam about 12 inches thick. The subsoil is brown extremely gravelly silt loam to a depth of 22 inches over bedrock.

The loamy-skeletal, mixed Andeptic Cryoboralfs are yellowish brown silt loam in the upper 11 inches of the surface layer. They are pale brown very gravelly silt loam in the lower 18 inches of the surface layer. The upper part of the subsoil is brown very gravelly clay loam about 14 inches thick. The lower part to a depth of 60 inches or more is brown very gravelly loam.

Management

Timber

The potential annual production is moderate on upper slopes and high on lower slopes. The slope severely limits

the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by plant competition on the upper slopes of northerly aspects. *Menziesia* competes vigorously with tree seedlings in open areas. Regeneration of the forest is limited by moisture stress on the upper slopes of southerly aspects.

Roads

The slope increases the quantity of material excavated during road construction. On upper slopes, the hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. Large stones can roll from roadcuts onto road surfaces causing a driving hazard. Material exposed during road construction is difficult to revegetate because of moisture stress. On lower slopes, tread erosion tends to remove fine textured material from unsurfaced roads. The remaining gravel and cobbles form a rough surface. Material exposed in cutbanks during road construction tends to slough if the cutbanks are steep.

Watershed

Logging skid trails and firelines have moderate erosion hazards. The material exposed by road construction has slight erosion hazards on upper slopes and moderate hazards on lower slopes. Sediment delivery efficiency is low on upper slopes and high on lower slopes.

74 Ochrepts, very steep

This map unit is on stream breaklands. Elevation ranges from 3,000 to 4,500 feet. The average annual precipitation is 25 to 40 inches. The vegetation is dry, mixed forest and lower subalpine forest. The soils formed in glacial drift or material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 60 to 90 percent. Stream breaklands consist of narrow V-shaped valley slopes along major streams. There are barren, rapidly eroding soils where streams are actively undercutting slopes.

Vegetation

The vegetation is a mixed forest of Douglas-fir, western white pine, lodgepole pine, western larch, Engelmann spruce and subalpine fir. The forest understory is dominated by shrubs and forbs. Pinegrass is common at lower elevations and *Menziesia* is common on northerly aspects at higher elevations.

Habitat Types

This unit is an undifferentiated group of habitat types. Douglas-fir/snowberry is common at lower elevations. Subalpine fir/beargrass and subalpine fir/*Menziesia* are common at higher elevations.

Geology

These soils are underlain by one of the following, depending on the location of the map unit: dense, brittle glacial till; outwash; or metasedimentary rocks.

Characteristics of the Soils

These soils have moderately coarse textured surface layers.

Map Unit Composition

The dominant soils are Ochrepts. They have weakly developed subsoils. Similar soils are Orthents. They do not have subsoils. The dominant and similar soils make up about 80 percent of the map unit.

Rock outcrop and dissimilar soils make up about 20 percent of the unit. The Rock outcrop is in areas throughout the map unit. The Aquepts are around seeps and springs in drainageways. They have mottled subsoils, are wet, and have low strength.

Representative Profile of the Soils

The dominant Ochrepts have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part is brown extremely cobbly loamy sand to a depth of 43 inches over bedrock.

Management

Timber

The potential annual production is moderate. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by plant competition and moisture stress. Pinegrass competes vigorously with tree seedlings in open areas at lower elevations. *Menziesia* competes vigorously with tree seedlings on northerly aspects at higher elevations.

Roads

The slope increases the quantity of material excavated during road construction. The material exposed in cutbanks tends to ravel if the slopes are steep. The stability of the slope should be evaluated before the roads are built. Landslides damage roads in places.

Watershed

Sediment delivery efficiency is high.

75 Rock outcrop, structural breaklands

This map unit is on structural breaklands. Elevation ranges from 3,200 to 9,500 feet. The unit is mostly limestone cliffs with talus bases. Some delineations are argillite or quartzite cliffs. Dominant slopes have gradients of 60 percent to nearly vertical.

Ledges contain small areas of shallow soils. These soils support grass, shrubs, and scattered Douglas-fir and subalpine fir.

This map unit has scenic value but is not suited for most land uses.

76 Rock outcrop-Ochrepts complex, structural breaklands

This map unit is on structural breaklands. Elevation ranges from 4,000 to 8,000 feet. The average annual precipitation is 30 to 80 inches. The vegetation is upper subalpine forest. The lower soil layers formed in material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 60 to 90 percent. These structural breaklands have slope shapes controlled by underlying bedrock. The dip of underlying rock strata is roughly perpendicular to the slopes. The unit has common avalanche paths. The drainage pattern is dendritic or parallel and drainages are widely spaced and weakly incised.

Vegetation

The vegetation is a mixed forest of whitebark pine, subalpine fir, Engelmann spruce and lodgepole pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir-whitebark pine/grouse whortleberry is the major habitat type. Subalpine fir/beargrass and subalpine fir/grouse whortleberry are similar habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/snowberry is on southerly aspects at low elevations. This habitat type supports dry, mixed forest. Subalpine fir/queencup beadlily is in drainages and on lower slopes. Subalpine fir/Menziesia is on northerly aspects at higher elevations. Both have a productivity for timber higher than that of the major habitat types.

Geology

This map unit is on fault escarpments and underlain by argillite, siltite, quartzite, and limestone of the Belt supergroup.

Characteristics of the Soils

These soils have moderately coarse textured surface layer of loess 4 to 16 inches thick. The loess has been influenced by volcanic ash. These soils have a depth of 20 to more than 60 inches over bedrock.

Map Unit Composition

Rock outcrop and Ochrepts make up about 85 percent of this map unit. The Rock outcrop is in areas throughout the map unit. Rubble land is similar. Rock outcrop and Rubble land make up about 45 percent of the map unit.

The Ochrepts have a surface layer of loess 4 to 14 inches thick. Similar soils are Andepts. They have a surface layer of loess 14 to 16 inches thick. These soils make up about 40 percent of the map unit.

Dissimilar soils make up about 15 percent of the unit. They are Aquepts and Orthents. The Aquepts are around seeps in drainages. They have mottled subsoils, are wet, and have low strength. Orthents are in areas throughout the map unit. They do not have subsoils and are less productive.

Representative Profile of the Soils

The Ochrepts have a loam surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part is brown extremely cobbly loamy sand to a depth of 43 inches over bedrock.

Management

Timber

The potential annual production is low in forested areas. Productivity in the map unit is limited by the Rock outcrop. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by the harsh subalpine climate.

Roads

The slope increases the quantity of material excavated during road construction. The hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. Large stones can roll from roadcuts onto road surfaces causing a driving hazard. Material exposed during road construction is difficult to revegetate because of moisture stress and the harsh climate. Avalanches can increase the cost of maintaining the roads.

Watershed

Erosion hazard should be evaluated on site. Sediment delivery efficiency is high.

77 Ochrepts-Rock outcrop complex, structural breaklands

This map unit is on structural breaklands. Elevation ranges from 4,000 to 8,000 feet. The average annual precipitation is 30 to 80 inches. The vegetation is upper subalpine forest. The lower soil layers formed in material derived from metasedimentary rocks.

Landform

The dominant slopes have gradients of 60 to 90 percent. These structural breaklands have slope shapes controlled by underlying bedrock. The dip of underlying rock strata is roughly perpendicular to the slopes. The landform has a few avalanche paths. The drainage pattern is dendritic and drainages are relatively, closely spaced and deeply incised.

Vegetation

The vegetation is a mixed forest of whitebark pine, subalpine fir, Engelmann spruce and lodgepole pine. The forest understory is dominated by forbs and low shrubs.

Habitat Types

Subalpine fir-whitebark pine/grouse whortleberry is the major habitat type. Subalpine fir/beargrass and subalpine fir/grouse whortleberry are similar habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar habitat types are in about 20 percent of the unit. Douglas-fir/snowberry is on southerly aspects at low elevations. This habitat type supports dry, mixed forest. Subalpine fir/queencup beadlily is in drainages and on lower slopes. Subalpine fir/Menziesia is on northerly aspects at higher elevations. Both have a productivity for timber higher than that of the major habitat types.

Geology

This map unit is on fault escarpments and underlain by argillite, siltite, quartzite, and limestone of the Belt supergroup. The unit is on fault escarpments.

Characteristics of the Soils

These soils have moderately coarse textured, a surface layer of loess 4 to 16 inches thick. The loess has been influenced by volcanic ash. These soils have a depth of 20 to more than 60 inches over bedrock.

Map Unit Composition

The dominant soils are Ochrepts. They have a surface layer of loess 4 to 14 inches thick. Similar soils are Andepts. They have a surface layer of loess 14 to 16 inches thick. These soils occupy about 70 percent of the map unit.

Rock outcrop is in areas throughout the map unit. Rubble land is similar. They make up about 20 percent of the map unit.

The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up about 10 percent of the unit. They are Aquepts. The Aquepts are around seeps in drainages. They have mottled subsoils, are wet, and have low strength.

Representative Profile of the Soils

The dominant Ochrepts have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part is brown extremely cobbly loamy sand to a depth of 43 inches over bedrock.

Management

Timber

The potential annual production is low in forested areas. Productivity in the map unit is limited by the Rock outcrop. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by the harsh subalpine climate.

Roads

The slope increases the quantity of material excavated during road construction. The hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. Large stones can roll from roadcuts onto road surfaces causing a driving hazard. Material exposed during road construction is difficult to revegetate because of moisture stress and the harsh climate. Avalanches can increase the cost of maintaining the roads. Road fills can fail where roads cross drainages. Drainage crossings should be carefully located to avoid unstable slopes.

Watershed

Erosion hazards should be evaluated on site. Sediment delivery efficiency is high.

78 Ochrepts-Rock outcrop complex, southerly aspects

This map unit is on glacial trough walls and structural breaklands. Elevation ranges from 3,200 to 5,500 feet. The average annual precipitation ranges from 20 to 65 inches.

The vegetation is dry, mixed forest. The lower soil layers form mainly in material derived from metasedimentary rocks.

Landform

The dominant slopes are on southerly aspects and have gradients of 60 to 90 percent. The glacial trough walls have straight slopes and a parallel drainage pattern. Structural breaklands have slope shapes controlled by underlying bedrock. Rock strata are roughly perpendicular to the slopes. The landform has a few avalanche paths. The drainage pattern is dendritic on structural breaklands.

Vegetation

The vegetation is an open-grown forest of Douglas-fir, lodgepole pine and western larch. The forest understory is dominated by shrubs and grasses. Pinegrass is common.

Habitat Types

Douglas-fir/snowberry and Douglas-fir/pinegrass are the major habitat types. These habitat types occupy about 80 percent of the unit.

Dissimilar soils make up about 20 percent dissimilar habitat types. Subalpine fir/beargrass is at higher elevations and supports subalpine forest.

Geology

These soils are on fault escarpments and are underlain by argillite, siltite, quartzite, and limestone of the Belt supergroup. Thin deposits of dense, brittle glacial till overlie the bedrock in some places, on glacial trough walls.

Characteristics of the Soils

These soils have moderately coarse textured, surface layer of loess 2 to 7 inches thick. The loess has been influenced by volcanic ash. The content of angular rock fragments ranges from 35 to 60 percent in the subsoil. These soils have a depth of 20 to more than 60 inches over bedrock.

Map Unit Composition

The dominant soils are Ochrepts. They make up about 50 percent of the map unit.

Rock outcrop is on upper slopes, spur ridges and knolls.

Rubble land is similar. They make up about 40 percent of the map unit.

The components of this unit are so intricately mixed that it was not practical to map them separately at the scale used.

Dissimilar soils make up about 10 percent of the unit. They are Aquepts. The Aquepts are around seeps and springs in drainageways. They have mottled subsoils, are wet, and have low strength.

Representative Profile of the Soils

The dominant Ochrepts have a surface layer of brown gravelly sandy loam about 19 inches thick. The upper part of the subsoil is grayish brown very gravelly sandy loam about 9 inches thick. The lower part is brown extremely cobbly loamy sand to a depth of 43 inches over bedrock.

Management

Timber

The potential annual production is low in forested areas. Productivity in the map unit is limited by the Rock outcrop. The slope limits the operation of tractors. Cable logging systems are safer and disturb the soil less than tractor logging systems. Regeneration of the forest is limited by moisture stress and plant competition. Pinegrass competes vigorously with tree seedlings in open areas.

Roads

The slope increases the quantity of material excavated during road construction. The hard rock frequently limits excavation. If the hard rock is excavated, the cut and fill material is extremely stony and has a low water-holding capacity. Unsurfaced roads are rough because of large stones or cobbles. Large stones can roll from roadcuts onto road surfaces causing a driving hazard. Material exposed during road construction is difficult to revegetate because of moisture stress. Avalanches can increase the cost of maintaining the roads.

Watershed

Erosion hazard should be evaluated on site. Sediment delivery efficiency is high on lower slopes and moderate on upper slopes.

Use and Management of the Soils

Following is a description of the use and management of the soils in the survey area. The properties that influence the productivity and suitability of the land for a variety of resource uses are described. The criteria utilized in developing interpretations for the detailed soil map units in the survey area also are described.

Timber

The survey area is predominantly forested. Douglas-fir, western larch, lodgepole pine, western white pine, Engelmann spruce, ponderosa pine, grand fir, western hemlock, and western redcedar are the principal commercial species. Currently, about 128 million board feet of timber is harvested annually from the survey area. The surface layer of soils, especially in areas where ash is present, is very permeable and has low bulk density. Using a tractor to log, pile slash, and prepare the site can result in the surface layer being mixed with other soil material or becoming compacted or displaced. As a result, productivity is reduced and erosion is a hazard (2). The operation of tractors should be carefully planned to minimize the extent of the area affected.

Timber Management and Productivity

Table 3 can be used by forest managers in planning the use of soils for production of wood products. Only the map units that have a forested component are listed in the table.

Tractor operation gives limitations that are incurred when rubber-tired or tracked vehicles are used to skid logs, pile brush, or perform similar forest management practices. The limitations are soil damage, slope, complex slope, and rock outcrop.

Soil damage is a management concern on soils vegetated with moist, mixed forest or subalpine forest where the slope is not so steep that it limits the operation of tractors. Soils supporting this vegetation are seldom dry enough that tractors can be operated on them without the surface layer becoming compacted. Most of the soils have a surface layer that has been influenced by volcanic ash. Operating tractors only when the soils are covered with snow; limiting the extent of the area on which the tractors are operated; and limiting the use of tractors to ground skidding only; all minimize soil damage.

The slope is a limitation in map units that have a dominant slope of 35 percent or more. Operating tractors on these slopes can be unsafe and cause the surface layer to be displaced or excessively mixed with other soil material. A cable logging systems helps to overcome this limitation.

Complex slope is a management concern in map units where the operation of tractors is both limited in areas where the slope is more than 35 percent and not limited in areas where the slope is less than 35 percent. A combination of tractor and cable logging systems helps to overcome this limitation.

Rock outcrop is a limitation in map units having both a rock outcrop component and slopes that are suited to the operation of tractors. The rock outcrop on ledges limits the operation of tractors. A cable logging system helps to overcome this limitation.

Regeneration gives limitations to forest regeneration in cutover or burned areas. The limitations in the survey area are frost pockets, moisture stress, competition, and harsh climate.

Frost pockets are low areas where cold air drainage accumulates at night. Frequent frosts during the growing season limit species adaptation and regeneration. This limitation is associated with stream bottoms, kames and kettles, and moraines in narrow U-shaped glacial valleys.

Moisture stress limits regeneration on southerly aspects. Surface soil temperatures in unshaded areas in summer can be lethal to seedlings. Moisture stress is a limitation on south-facing slopes of more than 35 percent.

Competition is a limitation when aggressive understory species invade openings in the forest canopy. It is a limitation in map units that have pinegrass or menziesia in the forest understory.

Harsh climate is a limitation resulting from the short growing season, persistent snowbanks, and exposure to wind in open areas. It is a limitation in map units that are vegetated with subalpine forest.

Sediment hazard gives the rating assigned to each map unit for the sediment hazard along skid trails and firelines and in other areas where the soils have been disturbed during logging and site preparation. The hazard is relative to the other map units in the survey area. The rating can be used to evaluate the need for erosion-and-sediment-control practices and to compare the hazard in alternative

areas. The hazard of erosion for the surface layer and the rating of sediment delivery efficiency are used to determine the sediment hazard. The susceptibility of the soils to erosion and the sediment delivery efficiency are given in table 6. In Table 3 map units rated *slight* have a slight hazard of erosion in the surface layer. Map units rated *moderate* have a moderate or severe hazard of erosion in the surface layer and low or moderate sediment delivery efficiency. Map units rated *severe* have a severe hazard of erosion in the surface layer and moderate or high sediment delivery efficiency or a moderate or severe hazard of erosion in the surface layer and high sediment delivery efficiency.

Nonforested area gives the percentage of each map unit that generally is rock outcrop or is vegetated by shrub or meadow plant communities. The productivity for timber is reduced in proportion to the nonforest components.

Forest vegetative group gives the habitat type group. These groups have a relatively narrow range of timber productivity and similar limitations that affect forest regeneration. They are described under the heading "General Nature of the Survey Area".

Relative productivity gives the rating of relative timber productivity for forest components of the map units. The relative productivity is based on stand conditions and soil properties. Site index data is not available for specific soils or map units, however, it has been collected for stands and provides a basis for estimating quantitative potential yield for soils. The potential productivity is estimated for each relative potential productivity class. The estimates are for the maximum mean annual increment attainable in a fully stocked, natural stand. The quantitative estimates provide the user with a general impression of potential timber productivity in the survey area. They should not be used if quantitative reliability is important.

Map units rated *high* have moist, mixed forest vegetation. In most of the units rated high, the surface layer is loess that has been influenced by volcanic ash. The estimated potential yield is 85 to 140 cubic feet per acre per year.

Map units rated *moderate* have dry, mixed forest or lower subalpine forest vegetation. They tend to be on southerly aspects or at low elevations. The estimated potential yield is 50 to 85 cubic feet per acre per year.

Map units rated *low* have upper subalpine forest vegetation or dry, mixed forest vegetation and soils 20 to 60 inches deep with coarse textured or strongly to moderately acid lower soil layers. Estimated potential yield is 20 to 50 cubic feet per acre per year.

Roads

Road construction is the main engineering use of soils in forest management. About 3 to 4 miles of road is

required to manage 1 square mile of timber. Several kinds of roads are constructed to be used in forest management. Arterial and collector roads generally are 12 feet wide and have a ditch, or they are 14 feet wide and have a rolling grade or have been outsloped to provide for drainage. Local logging roads generally are drained by rolling grades and water bars and occasionally by outsloping. They often are closed when logs are not being hauled. They generally are not surfaced.

Data in this section can be used when choosing among alternative road locations and designs. Land use planners can use it to evaluate feasibility of allocating land to uses requiring roads. Transportation planners can use it to evaluate alternative routes. Design engineers can use it to plan detailed onsite investigations of soil and geology. This information does not eliminate the need for onsite investigation and testing.

Engineering Properties and Classification

Table 4 gives estimates of the engineering properties and classification for material on road cutbanks and in roadfill. For most map units in the survey area, the material rated is the lowest part of the profile, which is at a depth of about 40 to 60 inches. The upper part of the subsoil, which is at a depth of about 20 to 40 inches, is rated when the dominant slopes in the map unit are less than 15 percent. Road construction on these areas requires only minor excavation. The estimates can be used in planning detailed onsite investigations. Estimates are based on field examination and laboratory tests of samples from the survey area.

USDA texture for road cutbanks is the dominant texture for the greater portion of the cutbank area in the map unit. Soil texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined in terms of sand, silt, and clay percentages in the fraction of soil that is less than 2 millimeters in diameter. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly". Textural terms are defined in the Glossary.

The *Unified classification* of the soils is determined according to the Unified soil classification system (1). The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than three inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC and silty and clayey soils as ML, CL, OL, MH, CH, and OH. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SW-SM.

Fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight

basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.425, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and on estimates made in the field.

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

Road Construction and Maintenance

Table 5 shows the limitations affecting road construction and maintenance in each of the detailed soil map units. This information can be used to compare construction and maintenance limitations on alternative road locations and to plan detailed onsite investigations.

Excavation for roads in the survey area is limited by slope, wetness, and hard rock.

The slope is a limitation because it increases the amount of material that is excavated during construction. If a map unit has dominant slopes of 60 percent or more, slope is a limitation.

Wetness is a limitation in map units where the soils have a fluctuating water table. During excavation in these units, the ground water is intercepted. In some areas soils with a fluctuating a water table are mapped with others that do not have a fluctuating water table. In these areas the extent of wetness must be determined by onsite investigation.

Hard rock is a limitation in areas where it is encountered during excavation because it increases the difficulty of excavation. It is a limitation in map units where rock outcrop is a named component and in map units where the dominant soils have bedrock within 20 inches of the surface.

Maintenance of cut and fill areas gives limitations to maintenance of road cutbanks and roadfill. The limitations are cutbank slough, cutbank ravel, landslides, and avalanches. The maintenance of cutbanks is limited by slough and ravel, and the maintenance of roadfill is limited by landslides and avalanches.

Cutbank slough is associated with a seasonal high water table or a perched seasonal high water table and a slowly permeable substratum. It is a limitation in map units that have a slope of more than 20 percent if the soil in the lower part of the profile was formed in compact glacial till; if the landform contains seeps or springs; or if the soils have a fluctuating water table.

Cutbank ravel is associated with friable moderately

coarse or coarse textured material containing rounded rock fragments. It is a limitation in map units that have slope of more than 20 percent if the soil in the lower part of the profile formed in friable glacial till or outwash.

Landslides and avalanches can damage roadfill and deposit debris on road surfaces. Landslides in drainageways occur on dissected glaciated mountain slopes. Avalanches occur in areas of glacial trough walls, glacial cirque headwalls, and structural breaklands.

Fill material used for surfacing roads gives the limitations of soil material if it is used as fill for road surfaces. Tread erosion, large stones, rut formation, and rock fall are the limitations. Surfacing the roads with suitable material helps to overcome all of the limitations except for rock fall.

Tread erosion is the removal of fine textured material from unsurfaced roads by sheet and rill erosion. The remaining gravel and cobbles form a rough surface. If fill is taken from a map unit where the soil material below the surface layer has a moderate or severe hazard of erosion, tread erosion is a limitation.

Large stones cause rough road surfaces, which are difficult to blade. If fill is taken from a map unit in which excavation is limited by hard rock or in which the soil in the lower part of the profile is very stony sandy loam that formed in friable glacial till, large stones are a limitation. When hard rock is excavated, large fragments of rock are mixed with the fill material.

If fill is taken from a map unit in which the content of rock fragments in the lower part of the profile is less than 35 percent, the formation of ruts is a management concern.

If fill is taken from a map unit that has dominant slopes of 60 to 80 percent and the road cutbanks are fractured bedrock or friable glacial till, rock fall is a hazard. The road cutbanks are very steep, and loose rock from the cutbanks can roll onto the road surface causing a driving hazard.

If fill material is taken from a map unit that has a slope of more than 15 percent and the soil in the lower part of the profile is coarse textured, a limitation of too sandy is assigned. The surface of the roads is loose and sandy when the soils are dry.

Revegetation shows limitations to establishing vegetation on road cuts and in areas of roadfill. The limitations in the survey area are moisture stress and harsh climate.

Moisture stress is a limitation affecting revegetation if hard rock is encountered during excavation, if the soil in the lower part of the profile is coarse textured and the slope is steep, or if the soil is vegetated with mountain grassland, open-grown forest, or dry, mixed forest. In map units where hard rock is encountered during excavation, the roadcuts tend to be fractured rock or fractured rock mixed with soil. The content of rock fragments in these

map units limits the water-holding capacity. The areas of fractured rock cannot support vegetation. In map units where the soil in the lower part of the profile is coarse textured and the slope is steep, the roadcuts and roadfill are mainly coarse textured material that has a low water-holding capacity. Map units that are vegetated with mountain grassland, open-grown forest, or dry, mixed forest receive limited rainfall in the summer or are on southerly aspects, which have a high rate of evapotranspiration. Mulching and planting species that can withstand the drought in the summer help to overcome moisture stress.

The harsh climate is a limitation affecting revegetation of map units on mountain ridges at the higher elevations. The short growing season and exposure to drying winds hinder the establishment of seedlings. Planting climatically adapted species helps to overcome this limitation.

Sediment hazard on roads gives the rating assigned to each map unit for the sediment hazard on roads. The hazard is relative to the other map units in the survey area. The rating can be used to evaluate the need for erosion-and-sediment-control practices and to compare the hazard in alternative areas. The erosion hazard and the rating of sediment delivery efficiency are used to determine the sediment hazard on roads. The erosion hazard for the soil in the lower part of the profile and the sediment delivery efficiency are given in table 6. The erosion hazard for the soil in the upper part of the subsoil is used in map units having dominant slopes of less than 15 percent. The erosion hazard for the soil in the upper part of the subsoil does not appear in table 6 but was determined using the same criteria for the erosion hazard of the rest of the profile.

Map units rated *slight* have a slight erosion hazard on roads and low or moderate sediment delivery efficiency. Map units rated *moderate* have a moderate erosion hazard on roads and a low or moderate sediment delivery efficiency or a slight erosion hazard and high sediment delivery efficiency. Map units rated *severe* have a moderate erosion hazard on roads and a high sediment delivery efficiency or a severe erosion hazard on roads and a low, moderate, or high sediment delivery efficiency.

Watershed

The survey area is in the headwaters of the Flathead River. It contains Hungry Horse Reservoir, a major hydro-electric power production facility. Water produced by survey area watersheds is used for recreation, fish habitat, irrigation, and municipal water supplies in addition to hydro-electric power generation. The survey area drains into Flathead Lake, a large lake, heavily used for recreation.

Forest management practices, including logging,

burning, road construction, and site preparation, can expose soils to erosion. The erosion can be a source of sediment in streams, lakes, and reservoirs. The sediment can damage the fish habitat, reduce the capacity of the reservoirs, and increase the cost of treating domestic water supplies. Soil and water conservation practices help to control erosion and minimize the amount of sediment in streams, lakes, and reservoirs.

Soil Erosion and Sedimentation

Table 6 gives the erosion hazard for the surface layer and the soil in the lower part of the profile and the rating for sediment delivery efficiency. It can be used to determine if onsite evaluation is needed. Watershed scientists use models, which require information from this table, to predict sediment yield.

Susceptibility of the soil to erosion gives the relative susceptibility of exposed soil to erosion. The ratings are based on observations of erosion in the survey area and on the properties of the soil. The *surface layer* gives the rating if practices that remove the vegetative cover and expose the surface layer to the hazard of erosion are applied. Logging skid trails, fire lines, and severely burned areas are examples. The *lower layer* gives the rating if practices that require excavation exposing the soil in the lower part of the profile to the hazard of erosion are applied. Roadcuts and fill slopes are examples.

A rating of *slight* is assigned to soil layers that have a loamy texture and a content of angular rock fragments ranging from 35 to 85 percent or a content of rounded rock fragments ranging from 60 to 85 percent. Soil layers formed in material weathered from metasedimentary rocks have a slight erosion hazard.

A rating of *moderate* is assigned to soils layers having a loamy texture and a content of rounded rock fragments ranging from 15 to 60 percent or a content of angular rock fragments ranging from 15 to 35 percent. Soil layers formed in loess that has been influenced by volcanic ash or in glacial till, have a moderate hazard of erosion.

A rating of *severe* is assigned to soil layers that have a sandy texture or a loamy or clayey texture and a content of rock fragments of less than 15 percent. Soil layers that formed in lacustrine deposits, sandy glacial outwash, or material weathered from granitic rocks have a severe erosion hazard.

In areas where the erosion hazard is moderate or severe, an onsite evaluation should be made to determine if erosion-and-sediment-control practices are necessary. Controlling erosion is more difficult in areas that have a severe erosion hazard than in those that have a moderate erosion hazard.

Sediment delivery efficiency is a rating of the relative probability of eroded soil reaching a stream channel and becoming sediment. It is used in evaluating the hazard of

sedimentation. The transport of eroded soil across the landscape is a complex process affected by many properties that must be evaluated on site. The properties of landforms that affect sediment delivery were considered when this rating was assigned. They include the type of landform, the slope, and the distance between drainageways.

Map units rated *low* are on mountain ridges, moraines, kames, terraces or landslide deposits, alluvial fans, cirque headwalls, cirque basins, mid and upper portions of both mountain slopes and glaciated mountain slopes, and upper portions of trough walls. Slopes generally are 10 to more than 60 percent. Most of the eroded soil is deposited before it reaches a drainage channel. Less than 10 percent of the landforms are close enough to the drainage channels for eroded soil to become sediment.

Map units rated *moderate* are on mid and upper trough walls, mid and lower portions of rolling and hilly glaciated mountain slopes, lower portions of mountain slope and moraines. They have a dendritic or parallel drainage pattern. The drainageways are widely spaced. Slopes generally range from 10 to 60 percent. About 10 to 40 percent of the landforms are close enough to the drainage channels for eroded soil to become sediment.

Map units rated *high* are on dissected mountain slopes, stream breaklands, stream bottoms, the lower portion of steep, glaciated mountain slopes, or the mid and lower portions of trough walls. The dissected mountain slopes, stream breaklands, and the lower portions of trough walls have slopes of 60 to 90 percent, and eroded soil can travel a relatively long distance to the drainage channel. The stream bottoms parallel large streams. Most soil erosion is close enough to a stream to be a sediment hazard. About 40 to 100 percent of these landforms are close enough to the drainage channel for eroded soil to become sediment.

Wildlife

The survey area contains diverse wildlife habitat and populations of many game and non-game wildlife species. Big game species include elk, moose, black bear, grizzly bear, whitetail deer, mule deer, bighorn sheep, mountain goat and mountain lion. Hunting big game is a popular recreation activity within the survey area. The survey area has large herds of elk and elk hunting is particularly popular.

Wildlife habitat management in the survey area normally consists of two general kinds of activities. Existing wildlife habitat values are identified and protected or enhanced by coordinating activities such as timber harvest, road construction and recreation use with use of habitat by wildlife. The habitat is also directly improved by applying practices to improve the quality of vegetation for wildlife use. An example is prescribed burning.

Soil properties, slope, elevation, aspect and other properties of the map unit in this survey directly affect the potential kind and amount of vegetation available for wildlife use and its accessibility. This survey can be used to help identify and inventory potential wildlife habitat. When inventorying wildlife habitat, soil survey map units can be used as sampling units, thereby holding relatively constant those properties affecting the potential kind and amount of vegetation and its accessibility to wildlife. When planning, the properties of map units can be used to evaluate potential habitat values of alternative areas and the potential for habitat improvement. The map unit descriptions describe some potential habitat values for wildlife. However, the importance of map unit properties in evaluating potential habitat value varies with different species and with the location of delineation boundaries. Wildlife biologists should be consulted when using this survey to evaluate potential habitat values of specific map units.

Recreation and Visual Quality

Recreational activities in the survey area include hunting, fishing, gathering firewood, berry picking, hiking, boating, cross-country skiing, and photographing nature. Soil properties, slope, aspect, elevation, vegetation, and other properties of the detailed map units affect suitability for recreational use. This survey can be used during the planning process to identify areas suitable for recreational use and limitations to maintaining visual quality. Specialists in recreational use and visual management should be consulted to determine which map unit properties affect the recreational use or visual quality objectives. The detailed map units can then be used to help identify suitable areas.

Wildfire

Plans for wildfire control are incorporated into land management plans and fire management plans. This soil survey can be used to estimate suppression costs and predict effect of fire on vegetation and soils.

The detailed soil map units identify the habitat types and describe the extent of their distribution within map units. The habitat types can be used to help predict the response of vegetation to fire.

Suppression costs are partially dependent on terrain and soil properties, which are described in the map unit descriptions. Slope, rock outcrop, and the content of rock fragments in the surface layer are some of the properties that affect the cost of constructing a fire line. The susceptibility of the surface layer to erosion is given in table 6. This information can be used to plan the erosion-control measures to be applied to soil that has been disturbed by fire suppression activities.

Minerals

This soil survey can be used to help evaluate the effect of mineral exploration activities on soils and vegetation and to determine the conservation practices that should be applied in areas being rehabilitated after exploration. The soils, vegetation, landform, and geology are described in

the detailed soil map unit descriptions. Table 5 gives limitations to excavation and revegetation of roadcuts and fill slopes. These limitations also apply to many kinds of mineral exploration activities. The map unit descriptions and table 5 can be used to determine which erosion-and-sediment-control practices should be applied following mineral exploration activities.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey (NCSS) has six categories (4). Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. Table 7 shows the classification of soils at the suborder level. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The soils of the survey area are classified according to the system. The taxonomic categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in "sol". An example is Inceptisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ochrept, "ochr" meaning pale, plus "ept" from Inceptisol.

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Cryochrepts ("Cry" meaning cold, plus "ochrept", the suborder of Inceptisol that have an ochric epipedon).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Andic Cryochrepts.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties that affect management. The properties are mostly those of horizons

where there is much biological activity below plow depth. Among the properties considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and presence of permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the properties used as family differentia. An example is Andic Cryochrepts, loamy-skeletal, mixed.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. Series were not recognized in this survey.

Soils in the survey area are in both cryic and frigid temperature regimes. The lower elevation boundary of subalpine fir climax forest was used as a vegetative indicator of the boundary between them. Soil temperature data from the survey area and much of the Northern Rocky Mountains indicate this is a close approximation.

Soils in the survey area are in the udic moisture regime and include some soils in the ustic moisture regime that are on steep southerly aspects, at lower elevations.

The soils in the survey area are both less than and more than 60 percent base saturated. Base saturation cannot be estimated accurately with field techniques. A limited amount of laboratory data indicates soils in the udic moisture regime that formed in parent material derived from quartzite, or in glacial till dominantly derived from quartzite, are dominantly less than 60 percent base saturated. Other soils are dominantly more than 60 percent base saturated. The dominant base saturation is assumed based on the parent material and the moisture regime.

All the soils in the survey area are placed in a mixed mineralogy class. This is based on a limited amount of laboratory data.

A representative pedon for each of the soils mapped in the survey area follows. The descriptions are arranged in alphabetical order by suborder. The representative pedons are preceded by a brief discussion of taxa at higher levels than the representative pedon. The range of important

characteristics of soils in the taxa follows the representative pedon. Soil colors are for moist soil unless otherwise indicated.

Andepts

Andepts in the survey area have a surface layer of loess that has been influenced by volcanic ash. The surface layer is more than 14 inches thick and has a bulk density ranging from 0.65 to 0.85 grams per cubic centimeter. Laboratory data indicate the loess contains 60 to 70 percent glass shards in the fine sand and silt particle-size fractions. X-ray refraction data indicate large amounts of amorphous material in the clay particle-size fraction.

Cryandepts

Cryandepts are the cold Andepts. In this survey area these soils are at elevations of 5,500 to 7,000 feet. They are mostly in cirque basins and occasionally on alpine ridges. These soils formed in loess mixed with rock fragments, that has been influenced by volcanic ash.

Entic Cryandepts

Entic Cryandepts are Cryandepts that have light or thin dark, colored surface layers. They are the only Andepts in the survey area.

Entic Cryandepts, Medial-Skeletal

Representative Pedon

O—1 inch to 0; black partially decomposed organic material.

A1—0 to 3 inches; black (10YR 2/1) gravelly silt loam, black (10YR 2/1) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few coarse roots; many very fine discontinuous interstitial pores; 30 percent pebbles; very strongly acid; smooth clear boundary.

A2—3 to 4 inches; brown (10YR 5/3) gravelly silt loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few coarse roots; many very fine discontinuous interstitial pores; 30 percent pebbles; medium acid; smooth clear boundary.

Bs1—4 to 10 inches; yellowish brown (10YR 5/6) very gravelly silt loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few coarse roots; many fine

discontinuous interstitial pores; 50 percent pebbles; neutral; smooth clear boundary.

Bs2—10 to 17 inches; yellowish brown (10YR 5/6) extremely gravelly silt loam; light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few coarse roots; few fine discontinuous interstitial pores; 65 percent pebbles; neutral; smooth diffuse boundary.

Bs3—17 to 20 inches; yellowish brown (10YR 5/6) extremely gravelly silt loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few fine discontinuous interstitial pores; 80 percent pebbles; neutral; smooth diffuse boundary.

Bs4—20 to 40 inches; brownish yellow (10YR 6/6), extremely gravelly silt loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few fine discontinuous interstitial pores; 90 percent pebbles; neutral.

R—40 inches; fractured calcareous argillite bedrock.

Location and Setting

Northwestern Montana, Flathead County, 2,600 feet west and 2,200 feet south of the NE corner, section 1, T. 33 N., R. 24W., detailed soil map unit 72. The profile described is on an alpine ridge. The parent material is loess that has been influenced by volcanic ash and mixed with rock fragments from underlying metasedimentary bedrock. Elevation is 6,900 feet. The vegetation is upper subalpine forest. The habitat type is whitebark pine-subalpine fir/grouse whortleberry.

Range of Characteristics

Bedrock is mainly at 20 to 40 inches, but can be at 40 to 60 inches.

A horizon:

Hue is 7.5YR or 10YR; value is 2 to 6 moist or dry; chroma is 1 to 3 moist or dry. The content of rock fragments ranges from 0 to 35 percent. The horizon is 2 to 9 inches thick.

Bs horizons:

Hue is 7.5YR or 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 moist or dry. The content of rock fragments ranges from 35 to 90 percent.

Aquepts

Aquepts in this survey area are in depressional areas on flood plains, terraces and moraines. They have fluctuating water tables which are near the surface during

spring and early summer. These soils formed in silty lacustrine or alluvial deposits.

Aquepts

Representative Pedon

- O—3 inches to 0; mosses, roots, and litter; clear smooth boundary.
- Ag—0 to 7 inches; light brownish gray (2.5Y 6/2) silt loam, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown (10YR 5/6 and 5/8) and grayish brown (10YR 5/2) mottles; moderate medium platy structure parting to moderate thin platy; slightly hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine discontinuous interstitial pores; slightly acid; diffuse wavy boundary.
- Bgx—7 to 11 inches; light brownish gray (2.5Y 6/2) silt loam, light gray (10YR 7/1) dry; common fine distinct strong brown (7.5YR 5/6 and 5/8) and pinkish gray (7.5YR 6/2) mottles; moderate, coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; dense and somewhat brittle; common very fine discontinuous random tubular pores; neutral; clear wavy boundary.
- Bg—11 to 18 inches; light yellowish brown (2.5Y 6/4) silt, light gray (10YR 7/1) dry; many coarse prominent strong brown (7.5YR 5/6 and 5/8) and pinkish gray (7.5YR 5/2) mottles; moderate, coarse subangular blocky structure; hard, firm, nonsticky and nonplastic; few very fine discontinuous random tubular pores; neutral; clear wavy boundary.
- Cg—18 to 60 inches; light gray (2.5Y 7/2) and pale yellow (2.5Y 7/4) variegated silt, light gray (10YR 7/1) and white (10YR 8/1) dry; moderate medium platy structure; hard, firm, nonsticky and nonplastic; few very fine discontinuous random tubular pores; strongly effervescent; moderately alkaline.

Location and Setting

Northwestern Montana, Flathead County; 150 feet west and 1,300 feet north of the SE corner, section 15, T. 29N, R. 25W., detailed soil map unit 14-3. The profile described is in a depression on a moraine. The parent material is silty lacustrine deposits. Elevation is 4,500 feet. The vegetation is wet forest. The habitat type is subalpine fir/bluejoint.

Range of Characteristics

A horizon:

Hue is 2.5Y or 10YR; value is 2 to 6 when moist and 4 to 8 when dry; and chroma is 1 to 3 moist or dry.
Texture is sandy loam to silty clay loam. The content

of rock fragments ranges from 0 to 35 percent. Reaction is neutral to slightly acid. The horizon is 4 to 15 inches thick.

B horizons:

Hue is 2.5Y or 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and dominant chromas are 1 to 8. Texture is sandy loam to silty clay loam. The content of rock fragments ranges from 0 to 60 percent. Moist consistency is friable to firm. Reaction is neutral to slightly acid. The horizon is 6 to 23 inches thick.

C horizon:

Hue is 2.5Y or 10YR; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 1 to 4 moist and dry. Texture is sand to silty clay loam. The content of rock fragments ranges from 0 to 85 percent. Reaction is neutral to moderately alkaline. The horizon is noneffervescent or effervescent.

Boralfs

Boralfs are soils that have an accumulation of clay in the subsoil. Many of the Boralfs in the survey area have a surface layer of loess that has been influenced by volcanic ash. Boralfs tend to be fertile soils. Their productivity for timber is relatively high.

Boralfs

Representative Pedon

- Bs—0 to 8 inches: brown (7.5YR 4/4) silt loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and medium, few coarse roots; common fine discontinuous interstitial pores; 10 percent pebbles; slightly acid; abrupt wavy boundary.
- 2E—8 to 17 inches; pale brown (10YR 6/3) very gravelly silt loam, white (2.5Y 8/2) dry; weak medium subangular blocky structure; soft, friable, nonsticky and nonplastic; common fine and medium roots; many coarse constricted vesicular pores; 40 percent pebbles; medium acid; clear wavy boundary.
- 2Bt—17 to 31 inches; brown (10YR 5/3) very gravelly clay loam, light gray (2.5Y 7/2) dry; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common prominent clay films in pores; 35 percent pebbles; medium acid; gradual wavy boundary.
- 2BC—31 to 60 inches; brown (10YR 5/3) very gravelly loam, light gray (10YR 7/2) dry; weak medium subangular blocky structure; hard, firm, nonsticky and

nonplastic; few fine roots; few fine discontinuous interstitial pores; few faint clay films in pores; 45 percent pebbles; slightly acid.

Location and Setting

Northwestern Montana, Flathead County, 2,400 feet east and 1,100 feet south of NW corner, section 29, T. 32N., R. 20W., detailed soil map unit 32. The soil profile described is an Andeptic Cryoboralf, loamy-skeletal, mixed. The profile is on a landslide deposit bench. Slope is 30 percent. The parent material is loess that has been influenced by volcanic ash, and that is overlying landslide deposits derived from argillite and siltite. Vegetation is moist, mixed forest. The habitat type is subalpine fir/queencup beadlily.

Range of Characteristics

Bs horizon:

Hue is 10YR or 7.5YR; value is 3 to 5 moist and 4 to 6 dry; chroma is 3 or 4 moist or dry. Texture is loam or silt loam. The content of rock fragments ranges from 0 to 15 percent. Reaction is medium acid to neutral. The horizon is 4 to 12 inches thick.

2E horizon:

Hue is 10YR, 2.5Y or 7.5YR; value is 4 to 6 moist and 5 to 8 dry; chroma is 2 or 3 moist or dry. Texture is loamy sand, sandy loam, loam or silt loam. The content of rock fragments ranges from 15 to 40 percent. Reaction is strongly acid to slightly acid. The horizon is 4 to 14 inches thick.

2Bt horizon:

Hue is 10YR, 2.5Y or 7.5YR; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Texture is silt loam, loam, sandy clay loam, clay loam or silty clay loam. The content of rock fragments ranges from 15 to 60 percent. The horizon is 10 to 30 inches thick.

2BC horizon:

Hue is 10YR, 2.5Y or 7.5YR; value is 4 to 7 moist and 5 to 8 dry; chroma is 1 to 3 moist or dry. Texture is loamy sand sandy loam, loam or clay loam. The content of rock fragments ranges from 15 to 80 percent. Reaction is strongly acid to moderately alkaline.

Cryoboralfs

Cryoboralfs are the cold Boralfs. In this survey area Cryoboralfs are generally at elevations above 4,500 feet, but can be at elevations as low as 3,000 feet, on northerly aspects.

Andeptic Cryoboralfs

Andeptic Cryoboralfs are Cryoboralfs with loess surface layers that have been influenced by volcanic ash. These surface layers are 7 to 14 inches thick and have a bulk density ranging from 0.65 to 0.95 grams per cubic centimeter. The subsoils and substrata formed in material derived from glacial till or lacustrine deposits.

Andeptic Cryoboralfs, Loamy-Skeletal, Mixed

Representative Pedon

- A—0 to 3 inches; dark yellowish brown (10YR 4/4) silt loam, very pale brown (10YR 7/4) dry; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots, few coarse roots; many very fine discontinuous interstitial pores; 10 percent pebbles; strongly acid; abrupt smooth boundary.
- Bs—3 to 11 inches; dark yellowish brown (10YR 4/6) silt loam, light gray (10YR 7/2) dry; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots, few coarse roots; many very fine discontinuous interstitial pores; 10 percent pebbles; strongly acid; clear wavy boundary.
- 2E—11 to 29 inches; pale brown (10YR 6/3) very gravelly sandy loam, very pale brown (10YR 7/3) dry; moderate coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few very fine, fine and medium roots; common fine discontinuous interstitial pores; 35 percent pebbles; medium acid; clear wavy boundary.
- 2Bt—29 to 43 inches; brown (10YR 5/3) very gravelly sandy clay loam, very pale brown (10YR 7/3) dry; strong coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine discontinuous interstitial pores; common distinct clay films on faces of peds; 40 percent pebbles; neutral; gradual wavy boundary.
- 2Bk1—43 to 59 inches; brown (10YR 5/3) very gravelly sandy loam, very pale brown (10YR 7/3) dry; moderate coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots; few fine discontinuous interstitial pores; few faint clay films on faces of peds; 40 percent pebbles; lime disseminated throughout and coatings on the undersides of pebbles; strongly effervescent; mildly alkaline; gradual wavy boundary.
- 2Bk2—59 to 71 inches; brown (10YR 5/3) very gravelly sandy loam, very pale brown (10YR 7/3) dry; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 40 percent pebbles;

lime disseminated throughout and coatings on the undersides of pebbles; slightly effervescent; mildly alkaline.

Location and Setting

Northwestern Montana, Flathead County, 2,500 feet west and 2,600 feet north of SE corner, section 27, T. 37N., R. 22W., detailed soil map unit 26J-7. The profile described is on a moraine. Slope is 10 percent. The parent material is calcareous glacial till. Elevation is 4,100 feet. The vegetation is moist, mixed forest. The habitat type is subalpine fir/twinflower.

Range of Characteristics

A horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 2 to 4 moist or dry. Texture is silt loam or loam. The content of rock fragments ranges from 0 to 15 percent. The horizon is 0 to 4 inches thick.

Bs horizon:

Hue is 7.5 YR or 10YR; value is 4 to 5 when moist and 5 to 7 when dry; and chroma is 2 to 6 moist or dry. Texture is silt loam or loam. The content of rock fragments ranges from 0 to 15 percent. The horizon is 3 to 10 inches thick.

2E horizon:

Hue is 5YR to 10YR; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 or 3 moist or dry. Texture is silt loam, loam or sandy loam. The content of rock fragments ranges from 25 to 40 percent. Reaction is strongly acid to slightly acid. The horizon is 16 to 20 inches thick.

2Bt horizon:

Hue is 5YR to 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 moist or dry. Texture is clay loam, silty clay loam, sandy clay loam, sandy loam, loam, or silt loam. The content of rock fragments ranges from 35 to 55 percent. Reaction is slightly acid to neutral. The horizon is 12 to 30 inches thick.

2Bk horizons:

Hue is 5YR to 10YR; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 or 3 moist or dry. Texture is loam, silt loam, sandy loam or clay loam. The content of rock fragments ranges from 35 to 55 percent. Calcium carbonate equivalent is 5 to 35 percent. Where parent material is not calcareous the 2Bk horizons are replaced by 2Bt and 2C horizons. When 2C horizons are present they tend to be dense and brittle when moist, and have a dry

bulk density ranging from 1.5 to 1.8 grams per cubic centimeter.

Glossic Cryoboralfs

Glossic Cryoboralfs are Cryoboralfs that have albic materials tonguing into an argillic horizon. These soils formed in lacustrine deposits or glacial till that was derived from weathered rock or older sediments. They have loess mantles, 3 to 7 inches thick, that were influenced by volcanic ash. Some of these loess mantles are mixed with the underlying material.

Glossic Cryoboralfs, Fine-Silty, Mixed

Representative Pedon

- Bs—0 to 3 inches; dark yellowish brown (10YR 4/6) silt loam, yellowish brown (10YR 5/6) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and common medium roots; common very fine discontinuous interstitial pores; slightly acid; abrupt smooth boundary.
- 2E—3 to 12 inches; light gray (2.5Y 7/2) silt loam, white (2.5Y 8/2) dry; moderate coarse subangular blocky structure parting to weak medium platy; hard, friable, slightly sticky and nonplastic; few very fine roots; common very fine discontinuous tubular pores; strongly acid; clear wavy boundary.
- 2E/B—12 to 20 inches; 75 percent (E); light gray (2.5Y 7/2) silt loam, white (2.5Y 8/2) dry; with 25 percent (B) peds of pale yellow (2.5Y 7/4) silt loam, pale yellow (2.5Y 8/4) dry; moderate coarse subangular blocky structure parting to weak medium platy; hard, firm, slightly sticky and nonplastic; few very fine roots; few fine discontinuous interstitial pores; strongly acid; clear wavy boundary.
- 2B/E—20 to 27 inches; 70 percent (B); pale yellow (2.5Y 7/4) silt loam, pale yellow (2.5Y 8/4) dry; with 30 percent (E) light gray (2.5Y 7/2) silt loam, white (2.5Y 8/2) dry; tongues 3/4- to 1 inch wide; moderate coarse subangular blocky structure parting to weak medium platy; hard, firm, sticky and nonplastic; few very fine roots; few fine discontinuous interstitial pores; slightly acid; diffuse wavy boundary.
- 2Bt—27 to 45 inches; light yellowish brown (2.5Y 6/4) silt loam, pale yellow (2.5Y 8/4) dry; strong very coarse prismatic structure parting to moderate thick platy; hard, firm, sticky and nonplastic; few very fine roots; few very fine roots on faces of peds; few very fine discontinuous interstitial pores; common distinct clay films on faces of peds; neutral; diffuse wavy boundary.
- 2C—45 to 60 inches; light gray (10YR 7/1) silt loam, white (10YR 8/2) dry; massive, 2- to 3-inch laminations;

hard, firm, slightly sticky and nonplastic; few medium discontinuous tubular pores; neutral.

Location and Setting

Northwestern Montana, Flathead County, 300 feet east and 2,000 feet north of SW corner, section 23, T. 29N., R. 25W., detailed soil map unit 14-2. The profile described is in a depression on a moraine. The parent material is loess over silty, lacustrine deposits. The loess has been influenced by volcanic ash. Elevation is 4,900 feet. The vegetation is moist, mixed forest. The habitat type is subalpine fir/queencup beadlily.

Range of Characteristics

Bs horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 moist or dry. Reaction is neutral to slightly acid. The horizon is 2 to 7 inches thick.

2E horizon:

Hue is 2.5Y or 10YR; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 to 3 moist or dry. Reaction is medium acid or strongly acid. The horizon is 5 to 20 inches thick.

2E/B and 2B/E horizons:

Hue is 2.5Y or 10YR; E horizon material has value of 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 to 3 moist or dry. B horizon material have value of 6 to 7 when moist and 7 to 8 when dry; and chroma is 3 to 6 moist or dry. Reaction is slightly acid to strongly acid. The combined horizons are 10 to 20 inches thick.

2Bt horizon:

Hue is 2.5Y or 10YR; value is 6 to 7 when moist and 7 to 8 when dry; and chroma is 3 to 6 moist or dry. Texture is silt loam or silty clay loam. Reaction is slightly acid to neutral. The horizon is 15 to 30 inches thick.

2C horizon: Hue is 2.5Y or 10YR; value is 6 to 7 when moist and 7 to 8 when dry; and chroma is 1 to 2 moist or dry. Texture is silt, silt loam or silty clay loam. Reaction is neutral to moderately alkaline.

and coarse roots; common very fine discontinuous interstitial pores; 10 percent pebbles; medium acid; clear wavy boundary.

2E—6 to 10 inches; pale brown (10YR 6/3) gravelly silt loam, white (10YR 8/2) dry; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; common fine discontinuous interstitial pores; 20 percent pebbles; strongly acid; clear wavy boundary.

2E/B—10 to 17 inches; 70 percent (E); pale brown (10YR 6/3) gravelly silt loam, white (10YR 8/2) dry, 30 percent (B); yellowish brown (10YR 5/6) gravelly silt loam, yellow (10YR 7/6) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and nonplastic; few fine and medium roots; common fine discontinuous interstitial pores; 25 percent pebbles; strongly acid; gradual wavy boundary.

2B/E—17 to 23 inches; 80 percent (B); dark yellowish brown (10YR 4/4) gravelly silty clay loam, very pale brown (10YR 7/4) dry; 20 percent (E); pale brown (10YR 6/3) gravelly silty clay loam, white (10YR 8/2) dry; tongues 3/4- to 1 inch wide; moderate medium subangular blocky structure; hard, firm, slightly sticky and nonplastic; few fine and medium roots; common fine discontinuous interstitial pores; common prominent clay films on faces of peds and in pores; 25 percent pebbles; medium acid; gradual wavy boundary.

2Bt—23 to 34 inches; yellowish brown (10YR 5/4) gravelly silty clay loam, very pale brown (10YR 7/4) dry; moderate medium angular blocky structure; hard, firm, sticky and slightly plastic; few fine and medium roots; common distinct clay films on faces of peds and in pores; common fine discontinuous interstitial pores; 30 percent pebbles; neutral; gradual wavy boundary.

2Bk—34 to 67 inches; yellowish brown (10YR 5/4) gravelly silt loam, very pale brown (10YR 7/4) dry; moderate medium angular blocky structure; hard, firm, sticky and plastic; common fine discontinuous interstitial pores; 30 percent pebbles; violently effervescent, finely divided lime disseminated throughout, moderately alkaline.

Location and Setting

Northwestern Montana, Flathead County, 2,000 feet west and 1,100 feet south of NE corner, section 11, T. 19N., R. 16W., detailed soil map unit 26L-7. The profile described is on a glacial moraine. Slope is 10 percent. The parent material is loess over glacial till. The loess has been influenced by volcanic ash. The glacial till was derived from weathered, soft sedimentary or metasedimentary rocks. Elevation is 4,280 feet. The vegetation is moist, mixed forest. The habitat type is subalpine fir/queencup beadlily.

Glossic Cryoboralfs, Fine-Loamy, Mixed

Representative Pedon

O—1 inch to 0; semi-decomposed duff.

Bs—0 to 6 inches; brown (7.5YR 5/4) silt loam, pink (7.5YR 7/4) dry; weak fine granular structure; soft, friable, nonsticky and nonplastic; many fine medium

Range of Characteristics

Bs horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 when moist and 5 to 7 when dry; and chroma is 3 to 5 moist or dry. The content of rock fragments ranges from 0 to 15 percent. Reaction is medium acid to slightly acid. The horizon is 2 to 7 inches thick.

2E horizon:

Hue is 10YR or 2.5Y; value is 5 to 6 when moist and 6 to 8 when dry; and chroma is 2 to 5 moist or dry. Texture is silt loam or loam. The content of rock fragments ranges from 15 to 35 percent. Reaction is strongly acid to slightly acid. The horizon is 4 to 15 inches thick.

2E/B and 2 B/E horizons:

Hue is 7.5YR, 10YR or 2.5Y. E horizon material-value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 to 6 moist or dry. B horizon material-value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 when moist and dry. Texture is gravelly silt loam or silty clay loam. The content of rock fragments ranges from 15 to 35 percent. Reaction is very strongly acid to neutral. The combined horizons are 10 to 20 inches thick.

2Bt horizon:

Hue is 7.5YR, 10YR or 2.5Y; value is 4 to 6 when moist and 5 to 7 when dry; chroma is 3 to 6 moist or dry. Texture is silt loam or silty clay loam. The content of rock fragments ranges from 15 to 35 percent. Reaction is strongly acid to neutral. The horizon is 9 to 17 inches thick.

2Bk horizon:

Hue is 2.5YR to 5Y; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 3 to 6 moist or dry. Texture is silt loam or silty clay loam. The content of rock fragments ranges from 15 to 35 percent. Calcium carbonate equivalent is 5 to 15 percent. Reaction is medium acid to mildly alkaline. This horizon is not present in all pedons.

Eutroboralfs

Eutroboralfs are the cool, base-saturated Boralfs. The base saturation is 60 percent or more in the subsoil. In this survey area Eutroboralfs are at elevations below 5,000 feet.

Typic Eutroboralfs

Typic Eutroboralfs are freely drained Eutroboralfs having albic material that does not tongue into the argillic

horizon. They represent the central concept, or typical member, of the Eutroboralfs great group.

Typic Eutroboralfs, Loamy-Skeletal, Mixed

Representative Pedon

O—2 inches to 0; decomposed needles; many very fine and fine roots, few medium and coarse roots.

Bs—0 to 4 inches; dark yellowish brown (10YR 4/4) silt loam, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine and very fine roots, few medium and coarse roots; many very fine discontinuous interstitial pores; 5 percent pebbles; medium acid; abrupt smooth boundary.

2E—4 to 22 inches; pale brown (10YR 6/3) gravelly silt loam, very pale brown (10YR 7/3) dry; moderate medium subangular blocky structure; hard, firm, nonsticky and nonplastic; common very fine and fine roots, few medium roots; common fine discontinuous vesicular pores; 30 percent pebbles; medium acid; clear wavy boundary.

2Bt—22 to 30 inches; yellowish brown (10YR 5/4) very gravelly silt loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common fine discontinuous interstitial pores; common distinct clay films on faces of peds and in pores; 45 percent pebbles; neutral; clear wavy boundary.

2Bk30 to 60 inches; yellowish brown (10YR 5/4) extremely gravelly silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, firm, slightly sticky and nonplastic; common fine discontinuous vesicular pores; 65 percent pebbles; lime disseminated throughout and coatings on the undersides of pebbles; strongly effervescent; mildly alkaline.

Location and Setting

Northwestern Montana, Flathead County, 900 feet west and 1,700 feet north of SE corner, section 2, T. 28 N., R. 16W., detailed soil map unit 26G-7. The profile described is on a moraine. Slope is 5 percent. Elevation is 4020 feet. The parent material is loess over calcareous glacial till. The loess has been influenced by volcanic ash. The vegetation is moist, mixed forest. The habitat type is spruce/dwarf huckleberry.

Range in Characteristics:

Bs horizon:

Hue is 7.5YR or 10YR; value is 4 to 6 when moist and

5 to 7 when dry; and chroma is 3 to 4 moist or dry. The content of rock fragments ranges from 0 to 15 percent. The horizon is 0 to 6 inches thick.

2E horizon:

Hue is 10YR or 2.5Y; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 1 to 3 moist or dry. The content of rock fragments ranges from 15 to 50 percent. The horizon is 6 to 20 inches thick.

2Bt horizon:

Hue is 10YR or 2.5Y; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 moist or dry. The content of rock fragments ranges from 35 to 50 percent. The horizon is 7 to 14 inches thick.

2Bk horizon:

Hue is 10YR or 2.5Y; value is 5 to 7 when moist and 6 to 8 when dry; and chroma is 2 to 4 moist or dry. Texture is silt loam or loam. The content of rock fragments ranges from 35 to 65 percent. Calcium carbonate equivalent is 15 to 35 percent. Some pedons have a dense, brittle 2Cd horizon with dry bulk density of 1.5 to 1.8 grams per cubic centimeter.

Typic Eutroboralfs, Fine, Mixed

E—0 to 9 inches; reddish brown (5YR 4/4) gravelly silt loam, light brown (7.5YR 6/4) dry; moderate fine subangular blocky structure; hard, friable, nonsticky and nonplastic; 15 percent pebbles; common fine and medium roots; common medium continuous tubular pores, neutral; gradual wavy boundary.

Bt—9 to 22 inches; dark brown (7.5YR 4/4) gravelly clay loam, yellowish brown (10YR 5/4) dry; strong medium angular blocky structure; hard, firm, sticky and plastic; common very fine and medium roots; common medium continuous tubular pores; common distinct, clay films on faces of peds; 30 percent pebbles; neutral; gradual wavy boundary.

Bk—22 to 61 inches; dark yellowish brown (10YR 4/4) gravelly clay loam, dark brown (7.5YR 4/4) dry; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine discontinuous tubular pores; strongly effervescent; 30 percent pebbles; lime disseminated throughout and coatings on the undersides of pebbles; moderately alkaline.

Location and Setting

Northwestern Montana, Flathead County, 650 feet east and 800 feet north of SW corner, section 27, T. 25N., R. 15W., detailed soil map unit 26I-8. The profile described is on a northwest facing, glaciated mountain slope. Slope is 25 percent. Elevation is 4,900 feet. The parent material is

calcareous glacial till. Vegetation is dry, mixed forest. The habitat type is Douglas-fir/snowberry.

Range in Characteristics

Some pedons are mantled with loess that ranges from 1 to 6 inches thick. The loess has been influenced by volcanic ash. Dry bulk density ranges from 0.65 to 0.95 grams per cubic centimeter.

E horizon:

Hue is 5YR to 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 2 to 4 moist or dry. The content of rock fragments ranges from 0 to 20 percent. The horizon is 5 to 10 inches thick.

Bt horizon:

Hue is 5YR to 10YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 6 moist or dry. Texture is silty clay loam or clay loam. The content of rock fragments ranges from 15 to 35 percent. The horizon is 5 to 20 inches thick.

Bk horizon:

Hue is 5YR to 10YR; value is 4 to 6 when moist and 4 to 8 when dry; and chroma is 2 to 4 moist or dry. Texture is clay loam or silty clay loam. The content of rock fragments ranges from 10 to 35 percent. Calcium carbonate equivalent is 15 to 35 percent. When present, the 2Cd horizon has a dry bulk density of 1.5 to 1.8 grams per cubic centimeter.

Fluvents

Fluvents are on flood plains. The content of organic carbon in these soils decreases irregularly with increasing depth because of the flooding and the buried former surface layer. Fluvents are texturally stratified.

Fluvents

Representative Pedon

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; many very fine continuous interstitial pores; mildly alkaline; abrupt smooth boundary.

A2—8 to 10 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine, few medium roots; few very fine discontinuous horizontal tubular pores; mildly alkaline; abrupt smooth boundary.

C1—10 to 20 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; loose,

nonsticky and nonplastic; few very fine roots; many very fine continuous interstitial pores; mildly alkaline; abrupt smooth boundary.

C2—20 to 29 inches; brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; many very fine continuous interstitial pores; mildly alkaline; abrupt wavy boundary.

2C3—29 to 60 inches; weak red (2.5YR 5/2), greenish gray (5G 5/1), and gray (5YR 6/1) extremely gravelly sand; single grain; loose, nonsticky and nonplastic; 80 percent pebbles; neutral.

Location and Setting

Northwestern Montana, Flathead County, 1,050 feet west and 2,100 feet south of NE corner, section 7, T. 31N., R. 19W., detailed soil map unit 10-2. The profile described is a sandy, mixed, frigid Typic Udifluvent. It is on a nearly level flood plain along a stream. The parent material is texturally stratified alluvium. Elevation is 3,100 feet. The vegetation is moist, mixed forest and dry, mixed forest. The habitat type is Douglas-fir/snowberry.

Range of Characteristics

A horizon:

Hue is 7.5YR, 10YR or 2.5YR; value is 3 to 5 when moist and 5 to 7 when dry; and chroma is 2 to 3 moist or dry. Texture is silt loam, sandy loam, loamy sand, or sand. The content of rock fragments ranges from 0 to 60 percent. Reaction is neutral to mildly alkaline. The horizon is 5 to 10 inches thick.

C horizon:

Hue is 10R to 5G; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 1 to 4 moist or dry. Mixed colors are inherited from parent materials. Texture is stratified silt loam, loam, sandy loam, loamy sand or sand. The content of rock fragments ranges from 0 to 80 percent. Reaction is neutral to mildly alkaline.

Ochrepts

Ochrepts are soils having a light colored surface layer and not having a substantial accumulation of clay in the subsoil or a surface layer of loess influenced by volcanic ash that is thick enough to qualify for the Andept suborder. They are relatively young soils with some evidence of alteration of parent material and redistribution of minerals within the soil profile. They are expected, given time and proper conditions, to develop into soils representative of some other soil order.

Ochrepts

Representative Pedon

O—1 to 0 inches; slightly decomposed needles, twigs, and duff.

A—0 to 19 inches; brown (10YR 4/3) gravelly sandy loam, pale brown (10YR 6/3) dry; weak medium granular structure; soft, friable, nonsticky and nonplastic; many fine and common medium roots; 15 percent pebbles; slightly acid; clear wavy boundary.

Bw1—19 to 28 inches; grayish brown (10YR 5/2) very gravelly sandy loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; soft, friable, nonsticky and nonplastic; common fine and common medium roots; 30 percent pebbles and 10 percent cobbles; medium acid; clear wavy boundary.

Bw2—28 to 43 inches; brown (10YR 5/3) extremely cobbly loamy sand, pale brown (10YR 6/3) dry; weak medium granular structure; soft, friable, nonsticky and nonplastic; few fine roots; 35 percent pebbles and 30 percent cobbles; slightly acid; abrupt wavy boundary.

R—43+ inches; hard, fractured quartzite.

Location and Setting

Northwestern Montana, Flathead County, 600 feet west and 1,000 feet south of NE corner, section 26, T. 34N., R. 22W., detailed soil map unit 78. The profile described is a loamy-skeletal, mixed, frigid Typic Dystrochrept. It is on structural breakland. Slope is 65 percent. The parent material is derived from quartzite. The surface layer is mixed with loess that has been influenced by volcanic ash. Elevation is 4,600 feet. The vegetation is dry, mixed forest. The habitat type is Douglas fir/pinegrass.

Range of Characteristics

Ochrepts have surface layers that have formed in loess deposits 7 to 14 inches thick or loess that has been mixed with the underlying material. The loess has been influenced by volcanic ash. Depth to bedrock ranges from 20 to 60 inches or more. Bedrock is quartzite, siltite, argillite or limestone. The horizon is designated Bs when formed in loess deposits that are 7 to 14 inches thick.

A or Bs horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 when moist and 5 to 7 when dry; chroma is 2 to 4 moist or dry. Texture is silt loam, loam or sandy loam. The content of rock fragments ranges from 0 to 60 percent. Reaction is strongly acid to mildly alkaline. The horizon is 4 to 20 inches thick.

Bw horizons:

Hue is 7.5YR, 10YR or 2.5Y; value is 3 to 5 moist and

4 to 6 dry; chroma is 2 to 4 moist or dry. Texture is silt loam, loam, sandy loam or loamy sand. The content of rock fragments ranges from 15 to 80 percent. Reaction is strongly acid to moderately alkaline.

Eutrochrepts

Eutrochrepts are Ochrepts that have a base saturation of 60 percent or more in the subsoil. In this survey area they are on glacial outwash terraces and kames at elevations below 4,500 feet.

Dystric Eutrochrepts

Dystric Eutrochrepts are freely drained Eutrochrepts that do not have free carbonates above a depth of 40 inches. These soils formed in non-calcareous, glacial outwash and glaciofluvial deposits.

Dystric Eutrochrepts, Loamy-Skeletal, Mixed, Frigid

Representative Pedon

O—3 inches to 0; semi-decomposed needles and leaves.

Bs—0 to 6 inches; brown (7.5YR 4/4) very gravelly silt loam, yellowish brown (10YR 5/6) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; many fine discontinuous interstitial pores; 50 percent pebbles; slightly acid; clear wavy boundary.

2Bw1—6 to 15 inches; light yellowish brown (2.5Y 6/4) extremely cobbly sandy loam, pale yellow (2.5Y 7/4) dry; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; many fine discontinuous interstitial pores; 30 percent pebbles; 30 percent cobbles; medium acid; clear smooth boundary.

2Bw2—15 to 28 inches; light olive brown (2.5Y 5/4) extremely cobbly sandy loam, light yellowish brown (2.5Y 6/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine, few medium roots, many fine discontinuous interstitial pores; 35 percent pebbles, 25 percent cobbles; slightly acid, clear smooth boundary.

2C—28 to 60 inches; light yellowish brown (2.5 Y 6/4) extremely cobbly loamy sand, pale yellow (2.5Y 7/4) dry; single grain; loose, very friable, nonsticky and nonplastic; few fine and medium roots; many medium discontinuous interstitial pores; 30 percent pebbles; 30 percent cobbles; slightly acid.

Location and Setting

Northwestern Montana, Flathead County, 1,900 feet west and 1,350 feet south of NE corner, section 6, T. 28N., R. 18W., detailed soil map unit 27-7. The profile described is on a terrace. Slope is 10 percent. Elevation is 3,650 feet. The parent material is loess over glacial till. The glacial till has been reworked by water. The loess has been influenced by volcanic ash. Vegetation is moist, mixed forest. The habitat type is western redcedar/queencup beadlily.

Range of Characteristics

The profile is medium acid to neutral. Bedrock is 20 to more than 60 inches below the surface.

Bs horizon:

Hue is 7.5YR or 10YR; value is 4 to 5 when moist and 5 to 7 when dry; and chroma is 4 to 6 moist or dry. Texture is silt loam, loam or sandy loam. The content of rock fragments ranges from 10 to 60 percent. The horizon is 2 to 7 inches thick.

2Bw horizons:

Hue is 10YR or 2.5Y; value is 4 to 6 when moist and 5 to 8 when dry; and chroma is 1 to 4 moist and dry. Texture is loam or sandy loam. The content of rock fragments ranges from 35 to 80 percent. The horizon is 18 to 44 inches thick.

2C horizon: Hue is 10YR or 2.5Y; value is 5 to 7 when moist and 6 to 7 when dry; and chroma is 1 to 4 moist or dry. Texture is sandy loam, loamy sand or sand. The content of rock fragments ranges from 40 to 80 percent.

Cryochrepts

Cryochrepts are the cold Ochrepts. They are above elevations of 4,500 feet.

Andic Cryochrepts

Andic Cryochrepts are Cryochrepts with loess surface layers that are between 7 and 14 inches thick. The loess has been influenced by volcanic ash. In this survey area the Andic Cryochrepts are on glaciated mountain slopes and ridges, in cirque basins and on upper glacial trough walls. The subsoil and substrata have formed in glacial till or material derived from metasedimentary rocks.

Andic Cryochrepts, Loamy-Skeletal, Mixed

Representative Pedon

O—1 inch to 0; roots, needles and leaves.

A—0 to 4 inches; brown (7.5YR 5/2) gravelly silt loam, pinkish gray (7.5YR 7/2) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; many fine discontinuous interstitial pores; 15 percent pebbles; extremely acid; clear abrupt boundary.

Bs—4 to 12 inches; brown (7.5YR 4/4) very gravelly silt loam, strong brown (7.5YR 5/6) dry; moderate fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine, few medium roots; common very fine discontinuous interstitial pores; 45 percent pebbles; very strongly acid; diffuse wavy boundary.

2Bw—12 to 32 inches; brown (7.5YR 4/4) extremely gravelly silt loam, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine discontinuous interstitial pores; 80 percent pebbles; strongly acid; abrupt irregular boundary.

R—32 inches; fractured, slightly acid, strongly weathered argillite.

Location and Setting

Northwestern Montana, Flathead County, 1,800 feet west and 900 feet north of SE corner, section 25, T. 28N., R. 19W., detailed soil map unit 57-8. The profile described on a glaciated mountain ridge. Slope is 9 percent. Elevation is 6,200 feet. The parent material is loess over material weathered from argillite. The loess has been influenced by volcanic ash. The vegetation is lower subalpine forest. The habitat type is subalpine fir/grouse whortleberry, pinegrass phase.

Range of Characteristics

Bedrock is 20 to more than 60 inches below the surface. It is hard, fractured argillite, siltite, quartzite or limestone.

A horizon:

Hue is 10YR or 7.5YR; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 2 to 3 moist or dry. The content of rock fragments ranges from 0 to 35 percent. Reaction is extremely acid to slightly acid. Dry bulk density is 0.65 to 0.95 grams per cubic centimeter. The horizon is 0 to 4 inches thick.

Bs horizon:

Hue is 10YR or 7.5YR; value is 4 to 5 when moist and 5 to 6 when dry; and chroma is 3 to 6 moist or dry. Reaction is very strongly acid to slightly acid. The content of rock fragments ranges from 0 to 60 percent. Dry bulk density is 0.65 to 0.95 grams per cubic centimeter. The horizon is 7 to 14 inches thick.

2Bw horizon:

Hue is 7.5YR to 2.5Y; value is 4 to 6 when moist and 5 to 7 when dry; and chroma is 3 to 5 moist or dry. Texture is silt loam, loam or sandy loam. The content of rock fragments ranges from 35 to 85 percent. The horizon is 10 to 30 inches thick.

2C horizon:

This horizon is present only in some pedons. Texture is silt loam, loam or sandy loam. The content of rock fragments ranges from 35 to 85 percent. Some pedons have a dense, brittle 2Cd horizon with dry bulk density of 1.5 to 1.8 grams per cubic centimeter.

Dystric Cryochrepts

Dystric Cryochrepts are acid Cryochrepts that do not have volcanic ash influenced, loess surface layers that are thick enough to qualify for the Andic subgroup. The subsoil and substrata have formed in material derived primarily from quartzite. They are strongly to medium acid and have a base saturation of less than 60 percent. They are on glaciated mountain slopes or moraines. The subsoil and substrata are relatively infertile and productivity is highly dependent on the loess surface layer.

Dystric Cryochrepts, Loamy-skeletal, mixed

Representative Pedon

O—2 to 0 inches; partially decomposed leaves and needles with many medium and fine roots.

Bs—0 to 6 inches; dark yellowish brown (10YR 4/4) gravelly loam, pale brown (10YR 6/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and medium, few coarse roots; many very fine continuous interstitial pores; 25 percent pebbles; medium acid; abrupt and wavy boundary.

2A—6 to 14 inches; grayish brown (10YR 5/2) very gravelly very fine sandy loam, light gray (10YR 7/2) dry; weak fine granular structure; slightly hard, friable, nonsticky and nonplastic; common medium and coarse roots; few very fine discontinuous interstitial pores; 40 percent pebbles; strongly acid; clear and wavy boundary.

2Bw—14 to 27 inches; light brownish gray (10YR 6/2) very gravelly very fine sandy loam, light gray (10YR 7/2) dry; weak very fine subangular blocky structure; soft, friable, nonsticky and nonplastic; common medium and coarse roots; few very fine discontinuous interstitial pores; 45 percent pebbles; very strongly acid; diffuse and wavy boundary.

2Cd—27 to 60 inches; light brownish gray (10YR 6/2) very gravelly very fine sandy loam, light gray (10YR 7/2) dry; massive; hard, brittle, nonsticky and nonplastic; few medium and coarse roots in cracks; 50 percent pebbles; strongly acid.

Location and Setting

Northwestern Montana, Flathead County, 1,400 feet east and 800 feet south of NW corner, section 29, T. 26N., R. 21W., detailed soil map unit 26D-8. The profile described is on a glaciated mountain slope. Slope is 25 percent. Elevation is 4,800 feet. The parent material is glacial till derived primarily from quartzite. The surface layer was formed in loess that was mixed with the underlying material. The loess has been influenced by volcanic ash. Vegetation is lower subalpine forest. The habitat type is subalpine fir/beargrass, blue huckleberry phase.

Range of Characteristics

These soils are on moraines and glaciated mountain slopes. They formed in glacial till derived from quartzite on moraines and lower glaciated mountain slopes, and in material derived from quartzite on upper glaciated mountain slopes and ridgetops. In glacial till, they have a depth of 60 inches or more and the subsoil has 35 to 50 percent rounded rock fragments. When formed in material derived from quartzite, they are 20 to 60 inches deep over bedrock and the subsoil has 50 to 80 percent angular rock fragments.

Bs horizon:

Hue is 7.5YR or 10YR; value is 3 to 5 moist and 4 to 6 dry; chroma is 3 or 4 moist or dry. Texture is silt loam, loam, or very fine sandy loam. The content of rock fragments ranges from 0 to 35 percent. Reaction is medium acid to neutral. The horizon is 2 to 7 inches thick.

2A horizon:

Hue is 10YR or 2.5Y; value is 4 to 6 moist and 6 or 7 dry; chroma is 2 or 3 moist or dry. Texture is very fine sandy loam or sandy loam. The content of rock fragments ranges from 15 to 50 percent. Reaction is strongly acid to slightly acid. The horizon is 4 to 12 inches thick.

2Bw horizon:

Hue is 10YR or 2.5Y; value is 4 to 6 moist and 5 to 7 dry; chroma is 2 to 4 moist or dry. Texture is very fine sandy loam or sandy loam. The content of rock fragments ranges from 35 to 60 percent. Reaction is very strongly acid to medium acid. The horizon is 10 to 30 inches thick.

2Cd horizon:

Hue is 10 YR or 2.5Y; value is 4 to 6 moist and 5 to 7

dry; chroma is 2 or 3 moist or dry. Texture is very fine sandy loam, sandy loam or loamy sand. The content of rock fragments ranges from 35 to 80 percent. Reaction is strongly acid to medium acid. In some pedons, there is a 2C horizon that is friable when moist.

Saprists

Saprists are soils that have formed in organic deposits.

They have water tables at or near the soil surface most of the year. They are in depressions on flood plains, terraces and moraines. The vegetation is mainly wet meadow with some wet forest near delineation boundaries.

Borosaprists

Borosaprists are the cold Saprists. They are the only Saprists in the survey area.

Representative Pedon

- Oa1—0 to 8 inches; black (10YR 2/1) muck; weak fine granular structure; many fine roots; slightly acid.
 Oa2—8 to 12 inches; black (10YR 2/1) muck; weak fine granular structure; 25 percent pebbles; slightly acid.
 Oa3—12 to 16 inches; very dark brown (10YR 2/2) muck; weak fine subangular blocky structure; 10 percent pebbles; neutral; 3-inch thick discontinuous layer of yellowish brown (10YR 5/6) silt at lower edge of horizon.
 Oa4—16 to 28 inches; black (10YR 2/1) muck; weak fine subangular blocky structure; 15 percent pebbles; slightly acid.
 Oa5—28 to 61 inches; very dark brown (10YR 2/2) muck; weak fine subangular blocky structure; 5 percent pebbles; medium acid.

Location and Setting

Northwestern Montana, Flathead County, 2,250 feet east and 750 feet south of NW corner, section 5, T. 21N., R. 17W., detailed soil map unit 12. The profile described is in a depression on a glacial moraine. The vegetation is wet forest. The habitat type is subalpine fir/bluejoint.

Range of Characteristics

The water table is at or near the surface most of the year. The soil is dominantly muck, but some pedons have thin layers of mucky peat, peat or a thin, discontinuous layer of volcanic ash. The profile is neutral to strongly acid. The organic deposits overlie till, lacustrine deposits, or marl at a depth of 24 to more than 60 inches below the surface.

Formation of the Soils

Five principal factors affect soil formation. They are parent material, topography, biological activity, climate, and time. These soil-forming factors are interdependent; each modifies the effects of the others.

Soil is formed through the combined effects of these five factors. The differences in soils are mainly due to the relative importance or strength of the various factors. In mountainous areas such as the Flathead National Forest, changes in one or more soil-forming factors occur within relatively short distances. The many micro-climates that result from change in elevation, air drainage, topography, slope, and aspect strongly influence soil formation. Complexity of parent material, topography, and time also influence the kinds of soil in the area. The relative effects of each soil-forming factor in determining soil characteristics at any particular site are difficult to evaluate.

Some relationships between soil properties and parent material are obvious in the survey area. Most of the soils have a surface layer of loess that has been influenced by volcanic ash. Most of the volcanic ash is from the eruption of Mt. Mazama (Crater Lake, Oregon) in the year 6800 B.C. Volcanic ash from other sources, such as Glacier

Peak and several eruptions of Mt. St. Helens, also has been identified in the area. The depth of the loess surface layers is partially correlated with landscape position. The loess surface layer tends to be thicker on north-facing slopes and on concave slopes than on other slopes. It is undetectable on some steep, south-facing slopes. The loess is often diluted on some ridges and on the steeper slopes because it has been mixed with subsoil material. It generally is dark brown to reddish brown.

The parent material of the subsoil and substratum is derived from the underlying rocks, glacial drift, or lacustrine deposits. The subsoil and substratum of the soils formed in these kinds of parent material are dominantly medium textured to coarse textured. Those formed in weathered glacial till or lacustrine deposits can be moderately fine textured or fine textured. Some of the parent material of the subsoil and substratum is calcareous, and the soils that formed in this parent material can have free lime in the subsoil or substratum. If formed in compact glacial till, the substratum has bulk density of 1.5 to 1.8 grams per cubic centimeters when dry and is hard and brittle when moist.

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Glossary

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

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

Albic horizon. A light colored surface or lower horizon from which clay and free iron oxides have been removed or so segregated as to permit the color to be determined by the primary sand particles.

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

Alpine. Characteristic of high mountains, especially ones modified by intense glacial erosion. Implies high elevation and cold climate.

Aquic moisture. A reducing regime that is virtually free of dissolved oxygen regime because the soil is saturated by ground water.

Argillite. A compact rock derived from mudstone or shale composed primarily of clay-sized particles.

Argillic horizon. A diagnostic illuvial subsurface horizon characterized by an accumulation of silicate clays.

Ash, volcanic. Fine pyroclastic material smaller than 4.0 mm diameter. In this survey area, the volcanic ash qualifies as fine ash, less than 0.25 mm. diameter, because it is mostly in the silt and very fine sand-size range.

Association. A group of soils or miscellaneous areas geographically associated as a characteristic repeating pattern defined and delineated as a single map unit.

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

Basin. A depressed area with no or limited outlet.

Basin threshold. A bedrock lip at the entrance to a cirque basin. The threshold can impound a lake.

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

Block glide. A type of landslide in which blocks of layered bedrocks move along a bedding plane usually without rotation.

Boulders. Rock fragments larger than 2 feet in diameter.

Breaklands. The steep to very steep broken land at the border of an upland that is dissected by ravines or canyons.

Bulk density. The mass of dry soil per unit volume, expressed in grams per cubic centimeter.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil. A soil containing enough calcium carbonate and magnesium carbonate to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cambic horizon. A horizon which has been altered or changed by soil forming processes, usually occurring below a diagnostic surface horizon.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange. The total amount of exchangeable cations that can be held by capacity, the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value.

Channel. The bed of single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium.

Cirque. Semicircular, concave, bowl-like areas that have steep faces primarily resulting from glacial ice and snow abrasion.

Cirque basin. A half-amphitheater formed by alpine glaciation with three steep sides. Usually found at upper ends of valleys and along ridges. Often has a small lake in the basin.

Cirqueland. Glacial cirque headwalls and the associated talus and a cirque basin which commonly but not always, contains a small lake. Little or no vegetation grows in these areas.

Clay. The mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pored or root channels. Synonymous with clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured. Sand or loamy sand soil.

Cobble. Rock 3 to 10 inches in diameter.

Cobbly soil. Material that is 15 to 35 percent, by volume, rock fragments 3 to 10 inches in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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

Complex slope. Irregular or variable slope.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small an area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence at various soil moisture contents are:

Wet soil.—Nonsticky, slightly sticky, sticky, very sticky, nonplastic, slightly plastic, plastic, very plastic.

Moist soil.—Loose, very friable, friable, firm, very firm, extremely firm.

Dry soil.—Loose, soft, slightly hard, hard, very hard, extremely hard.

Creep. Slow mass movement of earth material down relatively steep slopes, primarily under influence of gravity but facilitated by water saturation and frost action.

Cryic. Soil temperature regime in which the mean annual soil temperature at 20 inches depth is higher than 0 degrees C but lower than 8 degrees C and the mean summer soil temperature is lower than 8 degrees C if an O horizon is present.

Cutbanks, road. The steep slope above a road from which material has been excavated during construction.

Delineation. A single enclosed area within a drawn

boundary line on a map. A single occurrence of a map unit.

Dendritic. A drainage pattern characterized by a treelike branching drainage system. system in which the tributaries join the main stream from all directions and at almost any angle.

Deposition. The laying down of potential rock-forming materials; sedimentation.

Deranged. A poorly integrated drainage system resulting from a relatively young landform having a flat or undulating topographic surface. These forms occur on moraines in the survey area.

Displacement. Repositioning or removal of the surface soil layers by mechanical action.

Drainage pattern. The spatial relationships among drainage channels, including geographic orientation and angles of intersection of channels. These are influenced by topographic relief, parent rock and soil materials.

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Droughty. An area or soil that characteristically has either a prolonged or chronic lack of available water.

Duff. A term used to identify an organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition.

Earthflow. See Flow (mass movement).

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

Erodibility. The tendency of a soil to be detached and carried away.

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

Erosion hazard. An interpretation of the risk of erosion associated with a specified management practice.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting.

Fan, alluvial. A low, outspread, gently sloping mass of loose rock material shaped like an open fan or a segment of a cone, deposited by a stream.

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

Fill, road. A structure, often composed largely of borrowed soil and rock materials, which forms the foundation upon which a road surface is constructed.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It is commonly is on the downhill side of a road.

Fine textured. Sandy clay, silty clay, and clay soil

Fireline. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of men and equipment in firefighting. Designated roads also serve as firebreaks.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially. It is usually a landform built of sediment deposited during overflow and lateral migration of the stream.

Flow (mass movement). A mass movement of unconsolidated material that exhibits a continuity of motion and a plastic or semifluid behavior resembling a viscous fluid. The mass of material moved by a flow.

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

Forest cover. All trees and other woody plants covering the ground in a forest.

Frigid. A soil temperature regime in which the soil at 20 inches depth has a mean temperature of 0 degrees C to 8 degrees C, and mean summer soil temperatures equal to or greater than 8 degrees.

Frost pocket. Accumulation of cold air in a topographic low or depression leading to unseasonal occurrence of frost.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surface features.

Glacial. Of or relating to the presence and activities of ice and glaciers, as glacial erosion. Pertaining to distinctive features and materials produced by or derived from glaciers and ice sheets, as glacial lakes. Pertaining to an ice age or region of glaciation.

Glacial till. Unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

Glaciation. The formation, movement and recession of glaciers or ice sheets. A collective term for the geologic processes of glacial activity, including erosion and deposition, and the resulting effects of such action on the earth's surface.

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

Gravel. Rounded or angular fragments of rock up to 3

inches in diameter. An individual piece is a pebble.

Gravelly soil. Material that is 15 to 50 percent, by volume, rounded or material angular rock fragments, not prominently flattened, up to 3 inches in diameter.

Ground water. All subsurface water, excluding internal water in the interior of the earth below the zone of saturation, as distinct from surface water.

Habitat type. All land areas potentially capable of producing similar plant communities at climax. Habitat types are named by the climax tree species in the first part of the name and a dominant undergrowth species in the second part of the name.

Headwall. The steep slope at the head of a valley; especially the rock cliff at the back of a cirque.

Herbage. The total production of grasses, forbs and shrubs available to livestock.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:
O horizon—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material.

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

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

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

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

Hummock. A rounded or conical mound or knoll, hillock or

other small elevation. Also, a slight rise of ground above a level surface.

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

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

Inclusion. Soil or vegetative bodies found within a map unit not extensive enough to be mapped separately or as part of a complex.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Lacustrine. Clastic sediments deposited in a lake deposit

Landform. Any physical, recognizable form or feature of the earth's surface, having a characteristic shape and produced by natural causes. Landforms used in this survey are described in the Physiography section.

Landscape. All the natural features, such as fields, hills, forests, and water, that distinguish one part of the earth's surface from another part. Also, the distinct association of landforms, especially as modified by geologic forces, that can be seen in a single view.

Landslide deposit. The landform produced by mass-wasting process, involving moderately rapid to rapid (greater than one foot per year) downslope transport, by means of gravitational stresses, of a mass of rock and regolith that may or may not be water saturated.

Landtype. Unit of land with similar designated soil, vegetation, geology, topography, climate, and drainage.

Leaching. The removal of soluble material from soil or other material by percolating water.

Limestone. A sedimentary rock consisting chiefly (more than 50%) of calcium carbonate, primarily in the form of calcite.

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

Lithologic. Pertaining to the physical character of a rock.

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

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

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

Map unit. The set of areas delineated on a map considered similar to all other members of the set (delineations) with respect to the selected properties used to define the set.

Mass wasting. Dislodgment and downslope transport of earth (regolith and rock) material as a unit under direct gravitational stress. The process includes slow

displacements such as creep, and solifluction, and rapid movements such as landslides, rock slides and gfalls, earthflows, debris flows, and avalanches.

Agents of fluid transport (water, ice, air) may play a subordinate role in the process.

Mean annual. The annual increase per acre in the volume of a stand. increment. Computed by dividing the total volume of a stand by its age. Abbreviated MAI.

Meander. One of a series of sinuous loops, with sine-wave form, in the course of a stream channel. Meandering streams commonly have cross sections with low width to depth ratios, fine-grained, cohesive bank material, and low gradient.

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

Metsedimentary. A sedimentary rock which shows evidence of having been rock. subject to metamorphism.

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

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine. An accumulation of unsorted earth and rock deposited by a glacier.

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

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms describe abundance, size and contrast.

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Munsell notation. A designation of color by degrees of the three simple variables: hue, value and chroma.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

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

Open-grown. Forests in which the free canopy does not close to shade the forest. Understory. Most have mean stockability of about 60 percent.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outcrop. That part of a geologic formation or structure that appears at the surface of the earth.

Outsloping. A road drainage practice in which the road surface is sloped away from the cutslope and drainage water is discharged on the fill slope.

Outwash. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Parallel. In the survey area, a local drainage pattern in which drainage pattern tributaries are parallel to one another and join the mainstream at right angles, characteristic of steeply sloping landforms and high energy streams.

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

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

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil.

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

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

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

Pleistocene. The first epoch of the Quaternary Period of geologic time, following the Tertiary Pliocene Epoch and preceding the Holocene (approximately from 2 million to 10 thousand years ago).

Precambrian. First era of geologic time (approximately 600 to 4,700 million years ago).

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

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

Puddling. Destruction natural soil structure by agitation with water.

Quartzite. Relatively hard rocks derived from metamorphosed sandstone.

Ravel. The movement of individual soil or gravel particles down a slope by gravitational force.

Reaction, soil. A measure of acidity or alkalinity of a soil,

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

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

Regeneration. The renewal of a tree crop by natural or artificial means.

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

Residuum. Unconsolidated, weathered, or partly weathered mineral material that only accumulates by disintegration of bedrock in place.

Ridge. A long narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys.

Riparian area. Areas within 100 horizontal feet of live water or areas that support plants or animals requiring free water.

Rippable. A material, usually bedrock, which can be mechanically dislodged using machines without resorting to the use of explosives.

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

Rock fall. Fall of cobble size and larger rocks from steep cutslopes onto the road surface.

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

Rock outcrop. Barren exposures of hard bedrock that is fractured in places. Some soil material is in cracks and crevices. In this survey area the rock is mostly metasedimentary rocks. When rock outcrop is on steep slopes it normally includes small areas of loose stones, cobble or gravel.

Rock structure. A weathered rock material in which the constituent parts remain in the same position with the same orientation as in the original rock.

Rock weathering. Transformation of rock by physical and chemical processes associated with the environment at the earth's surface.

Rolling grade. A road drainage practice in which the road grade is designed to provide low points at intervals to allow drainage water to escape.

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

Rotational slump. A landslide in which shearing takes place on a well defined, curved shear surface, concave upward in cross-section, producing a backward rotation in the displaced mass.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of an area without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Rutting. Furrows made in roads surfaces by the passage of wheeled vehicles over wet and plastic materials.

Sag pond. An undrained depression formed by slumps.

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

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Scour. The powerful and concentrated clearing and digging action of flowing air, water, or ice.

Sediment. Solid clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice or mass-wasting and has come to rest on the earth's surface either above or below sea level.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate.

Sediment delivery. The relative ease with which sediment produced in aefficiency. landscape reaches stream channels within the same landscape. This is the qualitative equivalent of the sediment delivery ratio which is the ratio of the sediment reaching streams to the amount eroded within a drainage area.

Sediment yield. The amount of material eroded from the land surface by runoff and delivered to a stream system.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter). to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltite. An indurated or somewhat indurated rock composed primarily of silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average

height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slough. Small landslides involving less than 10 cubic yards of material which detach from road cut slopes and fall on the road ditch and on the running surface.

Slump. A deep-seated, slow-moving, rotational failure occurring in plastic materials, resulting in vertical and lateral displacement.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solar insolation. Sum total of all long and short wave radiation intercepted by a slope.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches in diameter if rounded or 6 to 15 inches in length if flat.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stream order. In a drainage basin network, the smallest unbranched tributaries are designated stream order 1; the confluence of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3; etc. The order of a drainage basin is determined by the highest integer.

Stream reach. The length of a stream channel, uniform with respect to discharge, depth, area and slope, or a length of stream between two specified points.

Stream terrace. See terrace, stream.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), *granular* (rounded), *structureless* (soils are either single grained or massive).

Subgrade. The upper part of a road fill upon which the road surfacing components are placed.

Subsoil. Technically, the B horizon; roughly, the part of the solum below the surface soil.

Substratum. The part of the soil below the solum; the C horizon.

Surface layer. The uppermost layer in the soil, usually ranging in depth from 4 to 10 inches.

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling or sliding.

Taxonomic unit. A defined class at any categorical level in the soil classification system. The soil names for map units refer to taxonomic units.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace, stream. A step-like surface, bordering a valley floor or shoreline, that represents the former position of an alluvial plain, fan, or lake or seashore. The term is usually applied to both the relatively flat summit surface (platform, tread), cut or built by stream or wave action and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.

Tertiary. The first period of the Cenozoic Era of geologic time, following the Mesozoic Era and preceding the

Quaternary (approximately from 65 to 2 million years ago).

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. The sand, loamy sand and sandy loam classes may be further divided by specifying coarse, fine or very fine.

Thresholds. A lip of bedrock or moraine at the mouth of a glacial cirque. It may impound a small lake.

Till, glacial. See glacial till.

Topography. The relative position and elevations of the natural or manmade features of an area that describe the configurations of its surface.

Trough wall. Sideslopes of elongate, U-shaped valleys produced by glacial activity.

Udic moisture regime. A soil which, in the moisture-control section of the soil profile, is not dry (less than 15-bar soil water) in any part for as long as 90 days (cumulative) in most years and is not dry in all parts for as long as 45 consecutive days in the 4 months that follow the summer solstice in 6 or more years out of 10.

Upland. The elevated land above the low areas along streams or between hills; land above the footslope zone of the hillslope continuance.

Valley. An elongate, relatively large, externally-drained depression of the earth's surface that is primarily developed by stream erosion.

Volcanic ash. See loess, volcanic ash influenced.

Water bar. A shallow ditch excavated diagonally across a road surface to provide cross drainage.

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

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

Tables

TABLE 1.--Features Used to Plot Boundaries of Map Units
(Absence of an entry indicates that data were not estimated)

Map symbol	Landform	Slope	Parent Material	Vegetation	Elevation	Rock outcrop
		Pct				Pct
10-2	Stream bottoms	0-5	Alluvial deposits	Moist, mixed forest Dry, mixed forest	3,000-5,000	0
10-3	Stream bottoms	0-5	Alluvial deposits	Wet forest	3,000-4,500	0
12	Terraces, flood plains & moraines	0-2	Organic deposits	Wet meadows	3,000-5,100	0
14-2	Stream bottoms moraines	0-20	Lacustrine deposits	Moist, mixed forest	3,000-5,000	0
14-3	Stream bottoms, terraces & moraines	0-5	Lacustrine deposits	Wet forest	3,000-5,000	0
16	Alluvial fans	5-25	Alluvial deposits	Moist, mixed forest	3,100-4,800	0
17	Avalanche debris fans	20-50	Avalanche debris	Shrub communities	3,500-5,500	0
21-8	Cirque basins	20-40	Glacial till Metasedimentary rocks	Upper subalpine forest	5,500-7,000	20
21-9	Cirque basins	40-60	Glacial till Metasedimentary rocks	Upper subalpine forest	5,500-7,000	20
23-7	Glaciated mountain slopes and ridges	10-20	Glacial till Metasedimentary rocks	Moist, mixed forest Dry, mixed forest	3,000-7,000	0
23-8	Glaciated mountain slopes and ridges	20-40	Glacial till Metasedimentary rocks	Moist, mixed forest Dry, mixed forest	3,000-7,000	0
23-9	Glaciated mountain slopes and ridges	40-60	Glacial till Metasedimentary rocks	Moist, mixed forest Dry, mixed forest	3,000-7,000	0
24-8	Glaciated mountain slopes and ridges	20-40	Glacial till Metasedimentary rocks	Lower subalpine forest	3,000-6,500	0
24-9	Glaciated mountain slopes	40-60	Glacial till Metasedimentary rocks	Lower subalpine forest	3,000-6,500	0
26A-7	Moraines	10-20	Glacial till	Moist, mixed forest	3,000-5,500	0
26A-8	Glaciated mountain slopes	20-40	Glacial till	Moist, mixed forest	3,000-5,500	0
26A-9	Glaciated mountain slopes	40-60	Glacial till	Moist, mixed forest	3,000-5,500	0
26C-7	Moraines	10-20	Glacial till	Moist, mixed forest	3,000-5,500	0
26C-8	Glaciated mountain slopes	20-40	Glacial till	Moist, mixed forest	3,000-5,500	0
26C-9	Glaciated mountain slopes	40-60	Glacial till	Moist, mixed forest	3,000-5,500	0

TABLE 1.--Features Used to Plot Boundaries of Map Units--Continued

Map symbol	Landform	Slope	Parent Material	Vegetation	Elevation	Rock outcrop
		Pct				Pct
26D-7	Moraines	10-20	Glacial till	Lower subalpine forest	3,000-5,500	0
26D-8	Glaciated mountain slopes	20-40	Glacial till	Lower subalpine forest	3,000-5,500	0
26D-9	Glaciated mountain slopes	40-60	Glacial till	Lower subalpine forest	3,000-5,500	0
26G-7	Moraines	10-20	Glacial till	Dry, mixed forest	3,000-4,500	0
26G-8	Glaciated mountain slopes	20-40	Glacial till	Dry, mixed forest	3,000-4,500	0
26I-7	Moraines	10-20	Glacial till	Dry, mixed forest	4,000-5,000	0
26I-8	Glaciated mountain slopes	20-40	Glacial till	Dry, mixed forest	4,000-5,000	0
26J-7	Moraines	10-20	Glacial till	Moist, mixed forest	3,100-5,500	0
26J-8	Glaciated mountain slopes	20-40	Glacial till	Moist, mixed forest	3,100-5,500	0
26J-9	Glaciated mountain slopes	40-60	Glacial till	Moist, mixed forest	3,100-5,500	0
26L-7	Moraines	10-20	Glacial till	Moist, mixed forest	3,000-5,000	0
26L-8	Glaciated mountain slopes	20-40	Glacial till	Moist, mixed forest	3,000-5,000	0
26L-9	Glaciated mountain slopes	40-60	Glacial till	Moist, mixed forest	3,000-5,000	0
27-7	Kames and kettles or terraces	10-20	Glacial till	Dry, mixed forest	3,000-4,100	0
27-8	Kames and kettles or terraces	20-40	Glacial till	Dry, mixed forest	3,000-4,100	0
28-7	Terraces	0-20	Glacial outwash	Dry, mixed forest	3,000-4,100	0
31	Landslide deposits	10-30	Landslide deposits Metasedimentary rocks	Moist, mixed forest	3,100-5,000	0
32	Landslide deposits	15-60	Landslide deposits Metasedimentary rocks	Moist, mixed forest	4,000-6,000	0
54	Cirque basins	10-30	Metasedimentary rocks	-----	5,500-7,500	100
55	Glaciated mountain slopes	40-60	Metasedimentary rocks	-----	3,300-5,500	100
57-8	Glaciated mountain ridges	20-40	Metasedimentary rocks	Lower subalpine forest	4,000-7,500	0
57-9	Glaciated mountain ridges	40-60	Glacial till Metasedimentary rocks	Lower subalpine forest	4,000-7,500	0
72	Cirque headwalls and alpine ridges	60-90	Metasedimentary rocks	Upper subalpine forest	6,000 -10,000	60

TABLE 1.--Features Used to Plot Boundaries of Map Units--Continued

Map symbol	Landform	Slope	Parent Material	Vegetation	Elevation	Rock outcrop
		<u>Pct</u>				<u>Pct</u>
73	Glacial trough walls	60-90	Glacial till Metasedimentary rocks	Lower subalpine forest Moist, mixed forest	3,500-6,000	0
74	Stream breaklands	60-90	Glacial drift Metasedimentary rocks	Dry, mixed forest Lower subalpine forest	3,000-4,500	0
75	Structural breaklands	60-90	Limestone	-----	3,200-9,500	100
76	Structural breaklands	60-90	Metasedimentary rocks	Upper subalpine forest	4,000-8,000	45
77	Structural breaklands	60-90	Metasedimentary rocks	Upper subalpine forest	4,000-8,000	20
78	Glacial trough walls Structural breaklands	60-90	Metasedimentary rocks	Dry, mixed forest	3,200-5,500	40

Table 2.--Classification of the Soils in the Detailed Soil Map Units

Map symbol	Family or higher taxonomic classification
10-2-----	Fluvents
10-3-----	Aquepts
12-----	Borosaprists
14-2-----	Fine-silty, mixed Glossic Cryoboralfs
14-3-----	Aquepts
16-----	Fluvents
17-----	Ochrepts
21-8-----	Loamy-skeletal, mixed Andic Cryochrepts Medial-skeletal Entic Cryandepts
21-9-----	Loamy-skeletal, mixed Andic Cryochrepts Medial-skeletal Entic Cryandepts
23-7-----	Loamy-skeletal, mixed Andeptic Cryoboralfs Loamy-skeletal, mixed Andic Cryochrepts
23-8-----	Loamy-skeletal, mixed Andeptic Cryoboralfs Loamy-skeletal, mixed Andic Cryochrepts
23-9-----	Loamy-skeletal, mixed Andeptic Cryoboralfs Loamy-skeletal, mixed Andic Cryochrepts
24-8-----	Loamy-skeletal, mixed, Dystric Cryochrepts Loamy-skeletal, mixed, Dystric Cryochrepts
24-9-----	Loamy-skeletal, mixed, Dystric Cryochrepts Loamy-skeletal, mixed, Dystric Cryochrepts
26A-7-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26A-8-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26A-9-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26C-7-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26C-8-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26C-9-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26D-7-----	Loamy-skeletal, mixed Dystric Cryochrepts
26D-8-----	Loamy-skeletal, mixed Dystric Cryochrepts
26D-9-----	Loamy-skeletal, mixed Dystric Cryochrepts
26G-7-----	Loamy-skeletal, mixed Typic Eutroboralfs
26G-8-----	Loamy-skeletal, mixed Typic Eutroboralfs
26I-7-----	Fine, mixed Typic Eutroboralfs
26I-8-----	Fine, mixed Typic Eutroboralfs
26J-7-----	Loamy-skeletal, mixed Andeptic Cryoboralfs

Table 2.--Classification of the Soils in the Detailed Soil Map Units--Continued

Map symbol	Family or higher taxonomic classification
26J-8-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26J-9-----	Loamy-skeletal, mixed Andeptic Cryoboralfs
26L-7-----	Fine-loamy, mixed Glossic Cryoboralfs
26L-8-----	Fine-loamy, mixed Glossic Cryoboralfs
26L-9-----	Fine-loamy, mixed Glossic Cryoboralfs
27-7-----	Loamy-skeletal, mixed, frigid Dystric Eutrochrepts
27-8-----	Loamy-skeletal, mixed, frigid Dystric Eutrochrepts
28-7-----	Loamy-skeletal, mixed, frigid Dystric Eutrochrepts
31-----	Boralfs
	Ochrepts
32-----	Boralfs
	Ochrepts
57-8-----	Loamy-skeletal, mixed Andic Cryochrepts
57-9-----	Loamy-skeletal, mixed Andic Cryochrepts
72-----	Medial-skeletal Entic Cryandepts
73-----	Loamy-skeletal, mixed Andic Cryochrepts
	Loamy-skeletal, mixed Andeptic Cryoboralfs
74-----	Ochrepts
76-----	Ochrepts
77-----	Ochrepts
78-----	Ochrepts

Table 3.--Timber Management and Productivity

(Only map units with a forested component are listed--absence of an entry for a forested component indicates that data were not estimated)

Map symbol	Tractor operation	Regeneration	Sediment hazard	Non-forested area	Forest vegetative group	Relative productivity
				Pct		
10-2	Soil damage	Frost pockets	Severe	20	Moist, mixed forest	High
10-3	Wet areas	Competition, frost pockets.	Severe	0	Wet forest	Moderate
14-2	Soil damage	Frost pockets	Severe	0	Moist, mixed forest	High
14-3	Wet areas	Competition, frost pockets.	Severe	0	Wet forest	Moderate
16	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
21-8	Rock outcrop, soil damage	Harsh climate	Moderate	20	Upper subalpine forest	Low
21-9	Slope	Harsh climate	Moderate	20	Upper subalpine forest	Low
23-7	Soil damage	Competition on upper slopes and ridges.	Moderate	0	Moist, mixed forest Dry, mixed forest	High Moderate
23-8	Soil damage	Competition on upper slopes and ridges.	Moderate	0	Moist, mixed forest Dry, mixed forest	High Moderate
23-9	Slope	Competition on upper slopes and ridges.	Moderate	0	Moist, mixed forest Dry, mixed forest	High Moderate
24-8	Soil damage	Competition on upper slopes and ridges.	Moderate	0	Lower subalpine forest	Moderate
24-9	Slope	Competition on upper slopes and ridges.	Moderate	0	Lower subalpine forest	Moderate
26A-7	Soil damage	Frost pockets	Moderate	0	Moist, mixed forest	High
26A-8	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
26A-9	Slope	No limitations	Severe	0	Moist, mixed forest	High
26C-7	Soil damage	Frost pockets	Moderate	0	Moist, mixed forest	High
26C-8	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
26C-9	Slope	No limitations	Severe	0	Moist, mixed forest	High
26D-7	Soil damage	Frost pockets	Moderate	0	Lower subalpine forest	Moderate
26D-8	No limitations	No limitations	Moderate	0	Lower subalpine forest	Moderate
26D-9	Slope	No limitations	Severe	0	Lower subalpine forest	Moderate
26G-7	Soil damage	Competition, frost pockets.	Moderate	0	Dry, mixed forest	Moderate

Table 3.--Timber Management and Productivity--Continued

Map symbol	Tractor operation	Regeneration	Sediment hazard	Non-forested area	Forest vegetative group	Relative productivity
				<u>Pct</u>		
26G-8	No limitations	Competition	Moderate	0	Dry, mixed forest	Moderate
26I-7	Soil damage	Competition, frost pockets.	Moderate	0	Dry, mixed forest	Moderate
26I-8	No limitations	Competition	Moderate	0	Dry, mixed forest	Moderate
26J-7	Soil damage	Frost pockets	Moderate	0	Moist, mixed forest	High
26J-8	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
26J-9	Slope	No limitations	Severe	0	Moist, mixed forest	High
26L-7	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
26L-8	Soil damage	No limitations	Moderate	0	Moist, mixed forest	High
26L-9	Slope	No limitations	Severe	0	Moist, mixed forest	High
27-7	Soil damage	Moisture stress	Moderate	0	Dry, mixed forest	Moderate
27-8	Soil damage	Frost pockets, moisture stress.	Moderate	0	Dry, mixed forest	Moderate
28-7	Soil damage	Moisture stress	Moderate	0	Dry, mixed forest	Moderate
31	Complex slope, soil damage	No limitations	-----	0	Moist, mixed forest	High
32	Soil damage on benches, slope on escarpments	No limitations	-----	0	Moist, mixed forest	High
57-8	Soil damage	Moisture stress on southerly aspects.	Moderate	0	Lower subalpine forest	Moderate
57-9	Slope	Moisture stress on southerly aspects.	Moderate	0	Lower subalpine forest	Moderate
73	Slope	Competition on northerly aspect upper slopes, moisture stress on southerly aspect upper slopes.	Severe on lower slopes, moderate on upper slopes	0	Lower subalpine forest Moist, mixed forest	Moderate High
74	Slope	Competition	Severe	0	Dry, mixed forest Lower subalpine forest	Moderate Moderate
76	Slope	Harsh climate	Severe	45	Upper subalpine forest	Low
77	Slope	Harsh climate	Severe	20	Upper subalpine forest	Low
78	Slope	Moisture stress, competition.	Severe	40	Dry, mixed forest	Low

Table 4.--Engineering Index Properties

(Absence of an entry indicates that data were not estimated)

Map symbol	USDA Texture	Unified classification	Fragments >3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
				4	10	40	200		
			Pct					Pct	
12	-----	PT	0	---	---	---	---	---	---
14-2	Silt Loam	ML	0-5	100	100	90-100	70-90	20-30	5-10
21-8	Extremely gravelly silt loam	GM	10-50	30-40	30-40	25-35	20-30	10-20	0-5
	Bedrock	---	---	---	---	---	---	---	---
21-9	Extremely gravelly silt loam	GM	10-50	30-40	30-40	25-35	20-30	10-20	0-5
	Bedrock	---	---	---	---	---	---	---	---
23-7	Very gravelly silt loam and loam	GM	0-50	30-50	30-50	25-50	20-30	10-20	0-5
	Bedrock	---	---	---	---	---	---	---	---
23-8	Very gravelly silt loam and loam	GM	0-50	30-50	30-55	25-50	20-30	10-20	0-5
	Bedrock	---	---	---	---	---	---	---	---
23-9	Very gravelly silt loam and loam	GM	0-50	30-50	30-55	25-50	20-30	10-20	0-5
	Bedrock	---	---	---	---	---	---	---	---
24-8	Very gravelly very fine sandy loam, extremely gravelly fine sandy loam.	GM	0-50	35-50	25-45	20-35	12-20	---	NP
24-9	Very gravelly very fine sandy loam, extremely gravelly fine sandy loam.	GM	0-50	35-50	25-45	20-35	12-20	---	NP
26A-7	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26A-8	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26A-9	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26C-7	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26C-8	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26C-9	Very gravelly silt loam	GM	0-40	30-50	40-50	35-45	30-40	10-20	0-5
26D-7	Very gravelly very fine sandy loam	GM	0-40	30-50	25-45	20-35	12-20	---	NP
26D-8	Very gravelly very fine sandy loam	GM	0-40	30-50	25-45	20-35	12-20	---	NP

Table 5.--Road Construction and Maintenance

(Absence of an entry indicates that data were not estimated)

Map symbol	Excavation	Maintenance of cut and fill areas	Fill material used for surfacing roads	Revegetation	Sediment hazard on roads
10-2	No limitations	No limitations	No limitations	No limitations	Severe
10-3	Wetness	No limitations	Rutting	No limitations	Severe
12	Wetness	No limitations	Rutting	No limitations	Slight
14-2	No limitations	Cutbank slough on terrace risers.	Rutting	No limitations	Severe
14-3	Wetness	No limitations	Rutting	No limitations	Severe
16	Wetness	Cutbank ravel	No limitations	No limitations	Moderate
17	Wetness	Cutbank ravel, avalanches.	Large stones	No limitations	Slight
21-8	Hard rock	No limitations	Large stones	Moisture stress, harsh climate.	Slight
21-9	Hard rock	No limitations	Large stones	Moisture stress, harsh climate.	Slight
23-7	No limitations	No limitations	No limitations	Moisture stress on upper slopes and ridges.	Slight on upper slopes, moderate on lower slopes.
23-8	No limitations	No limitations	No limitations	Moisture stress on upper slopes and ridges.	Slight on upper slopes, moderate on lower slopes.
23-9	No limitations	No limitations	No limitations	Moisture stress on upper slopes and ridges.	Slight on upper slopes, moderate on lower slopes.
24-8	No limitations	Cutbank ravel	Tread erosion on lower slopes.	Moisture stress on upper slopes and ridges.	Slight on upper slopes, moderate on lower slopes.
24-8	No limitations	Cutbank ravel	Tread erosion on lower slopes.	Moisture stress	Slight on upper slopes, moderate on lower slopes.
26A-7	No limitations	No limitations	Tread erosion	No limitations	Moderate
26A-8	No limitations	Cutbank slough	Tread erosion	No limitations	Moderate
26A-9	No limitations	Cutbank slough	Tread erosion	No limitations	Severe
26C-7	No limitations	No limitations	Tread erosion	No limitations	Moderate
26C-8	No limitations	Cutbank slough	Tread erosion	No limitations	Moderate
26C-9	No limitations	Cutbank slough	Tread erosion	No limitations	Severe
26D-7	No limitations	No limitations	Tread erosion	No limitations	Moderate
26D-8	No limitations	Cutbank ravel	Tread erosion	No limitations	Moderate
26D-9	No limitations	Cutbank ravel	Tread erosion	No limitations	Severe

Table 5.--Road Construction and Maintenance--Continued

Map symbol	Excavation	Maintenance of cut and fill areas	Fill material used for surfacing roads	Revegetation	Sediment hazard on roads
26G-7	No limitations	No limitations	Tread erosion	Moisture stress	Moderate
26G-8	No limitations	Cutbank slough	Tread erosion	Moisture stress	Moderate
26I-7	No limitations	Cutbank slough	Rutting	Moisture stress	Severe
26I-8	No limitations	Cutbank slough	Rutting	Moisture stress	Severe
26J-7	No limitations	No limitations	Tread erosion	No limitations	Moderate
26J-8	No limitations	Cutbank slough	Tread erosion	No limitations	Moderate
26J-9	No limitations	Cutbank slough	Tread erosion	No limitations	Severe
26L-7	No limitations	No limitations	Rutting	No limitations	Moderate
26L-8	No limitations	Cutbank slough	Rutting	No limitations	Moderate
26L-9	No limitations	Cutbank slough	Rutting	No limitations	Severe
27-7	No limitations	No limitations	No limitations	Moisture stress	Slight
27-8	No limitations	Cutbank ravel	No limitations	Moisture stress	Slight
28-7	No limitations	No limitations	Tread erosion	Moisture stress	Slight
31	No limitations	Cutbank slough, landslides.	No limitations	No limitations	---
32	No limitations	Cutbank slough, landslides.	No limitations	No limitations	---
57-8	No limitations	No limitations	No limitations	No limitations	Slight
57-9	No limitations	Cutbank ravel	No limitations	No limitations	Slight
72	Slope, hard rock	Avalanches	Large stones, rock fall	Moisture stress	Slight
73	Slope, hard rock on upper slopes.	Cutbank slough on lower slopes.	Tread erosion on lower slopes, large stones and rock fall on upper slopes.	Moisture stress	Slight on upper slopes, severe on lower slopes.
74	Slope	Cutbank ravel, landslides.	No limitations	Moisture stress at lower elevations.	Severe
76	Slope, hard rock.	Avalanches	Large stones, rock fall.	Moisture stress, harsh climate	Moderate
77	Slope, hard rock.	Avalanches	Large stones, rock fall.	Moisture stress, harsh climate	Moderate
78	Slope, hard rock	Avalanches	Large stones, rock fall.	Moisture stress	Slight on upper slopes, moderate on lower slopes.

Table 6.--Soil Erosion and Sedimentation

(Absence of an entry indicates that data were not estimated)

Map symbol	Susceptibility of the soil to erosion		Sediment delivery efficiency
	Surface layer	Lower layer	
10-2	----	----	High
10-3	----	----	High
12	Slight	Slight	Low
14-2	Moderate	Severe	High
14-3	Moderate	Severe	High
16	Moderate	----	Low
17	----	----	Moderate
21-8	Moderate	Slight	Low
21-9	Moderate	Slight	Low
23-7	Moderate	Slight on upper slopes, moderate on lower slopes.	Moderate
23-8	Moderate	Slight on upper slopes, moderate on lower slopes.	Moderate
23-9	Moderate	Slight on upper slopes, moderate on lower slopes.	Moderate
24-8	Moderate	Slight on upper slopes, moderate on lower slopes.	Moderate
24-9	Moderate	Slight on upper slopes, moderate on lower slopes.	Moderate
26A-7	Moderate	Moderate	Moderate
26A-8	Moderate	Moderate	Moderate
26A-9	Moderate	Moderate	High
26C-7	Moderate	Moderate	Moderate
26C-8	Moderate	Moderate	Moderate
26C-9	Moderate	Moderate	High
26D-7	Moderate	Moderate	Moderate
26D-8	Moderate	Moderate	Moderate
26D-9	Moderate	Moderate	High
26G-7	Moderate	Moderate	Moderate
26G-8	Moderate	Moderate	Moderate
26I-7	Moderate	Severe	Moderate

Table 6.--Soil Erosion and Sedimentation--Continued

Map symbol	Susceptibility of the soil to erosion Surface layer	Susceptibility of the soil to erosion Lower layer	Sediment delivery efficiency
26I-8	Moderate	Severe	Moderate
26J-7	Moderate	Moderate	Moderate
26J-8	Moderate	Moderate	Moderate
26J-9	Moderate	Moderate	High
26L-7	Moderate	Moderate	Moderate
26L-8	Moderate	Moderate	High
26L-9	Moderate	Moderate	Moderate
27-7	Moderate	Slight	Low
27-8	Moderate	Slight	Low
28-7	Moderate	Slight	Low
31	----	----	Low
32	----	----	Low
57-8	Moderate	Slight	Low
57-9	Moderate	Slight	Moderate
72	Moderate	Slight	Low
73	Moderate	Slight on upper slopes, moderate on lower slopes.	Low on upper slopes, high on lower slopes.
74	----	----	High
75	----	----	High
76	Moderate	Slight	High
77	Moderate	Slight	High
78	----	Slight	Moderate on upper slopes, high on lower slopes.

Table 7.--Classification of the Soils (grouped by suborder)

Suborder	Family or higher taxonomic classification
Andepts-----	Medial-skeletal Entic Cryandepts
Aquepts-----	Aquepts
Boralfs-----	Boralfs Loamy-skeletal, mixed Andeptic Cryoboralfs Fine-loamy, mixed Glossic Cryoboralfs Fine-silty, mixed Glossic Cryoboralfs Fine, mixed Typic Eutroboralfs Loamy-skeletal, mixed Typic Eutroboralfs
Fluvents-----	Fluvents
Ochrepts-----	Ochrepts Loamy-skeletal, mixed Andic Cryochrepts Loamy-skeletal, mixed Dystric Cryochrepts Loamy-skeletal, mixed, frigid Dystric Eutrochrepts
Saprists-----	Borosaprists

Table 8.--Numerical Listing of Map Symbols and the Acreage of the Soils

Map symbol	Soil name	Acres
10-2----	Fluvents, stream bottoms-----	14,241
10-3----	Aquepts, stream bottoms-----	24,217
12-----	Borosaprists, depressions-----	4,368
14-2----	Glossic Cryoboralfs, lacustrine substratum-----	12,060
14-3----	Aquepts, lacustrine substratum-----	4,032
16-----	Fluvents, alluvial fans-----	6,608
17-----	Ochrepts, avalanche debris fans-----	743
21-8----	Andic Cryochrepts-Entic Cryandepts-Rock outcrop complex, cirque basins-----	63,343
21-9----	Andic Cryochrepts-Entic Cryandepts-Rock outcrop complex, cirque basins, steep-----	24,863
23-7----	Andeptic Cryoboralfs-Andic Cryochrepts complex, rolling-----	9,850
23-8----	Andeptic Cryoboralfs-Andic Cryochrepts complex, hilly-----	61,020
23-9----	Andeptic Cryoboralfs-Andic Cryochrepts complex, steep-----	78,652
24-8----	Dystric Cryochrepts, till substratum-Dystric Cryochrepts, residuum substratum complex, hilly-----	11,248
24-9----	Dystric Cryochrepts, till substratum-Dystric Cryochrepts, residuum substratum complex, steep-----	35,181
26A-7----	Andeptic Cryoboralfs, silty till substratum, calcareous, rolling-----	30,686
26A-8----	Andeptic Cryoboralfs, silty till substratum, calcareous, hilly-----	51,495
26A-9----	Andeptic Cryoboralfs, silty till substratum, calcareous, steep-----	22,889
26C-7----	Andeptic Cryoboralfs, silty till substratum, rolling-----	100,501
26C-8----	Andeptic Cryoboralfs, silty till substratum, hilly-----	91,043
26C-9----	Andeptic Cryoboralfs, silty till substratum, steep-----	26,740
26D-7----	Dystric Cryochrepts, rolling-----	25,556
26D-8----	Dystric Cryochrepts, hilly-----	25,474
26D-9----	Dystric Cryochrepts, steep-----	10,335
26G-7----	Typic Eutroboralfs, silty till substratum, rolling-----	33,124
26G-8----	Typic Eutroboralfs, silty till substratum, hilly-----	19,328
26I-7----	Typic Eutroboralfs, clayey till substratum, rolling-----	1,009
26I-8----	Typic Eutroboralfs, clayey till substratum, hilly-----	1,699
26J-7----	Andeptic Cryoboralfs, sandy till substratum, rolling-----	17,724
26J-8----	Andeptic Cryoboralfs, sandy till substratum, hilly-----	11,941
26J-9----	Andeptic Cryoboralfs, sandy till substratum, steep-----	1,314
26L-7----	Glossic Cryoboralfs, till substratum, rolling-----	4,341
26L-8----	Glossic Cryoboralfs, till substratum, hilly-----	5,583
26L-9----	Glossic Cryoboralfs, till substratum, steep-----	209
27-7----	Dystric Eutrochrepts, till substratum-----	58,965
27-8----	Dystric Eutrochrepts, till substratum, steep-----	10,188
28-7----	Dystric Eutrochrepts, outwash substratum-----	29,520
31-----	Boralfs-Ochrepts complex, landslide deposits-----	3,702
32-----	Boralfs-Ochrepts complex, landslide deposits, steep-----	12,386
54-----	Cirqueland-----	8,645
55-----	Rock outcrop, glaciated mountain slopes-----	6,873
57-8----	Andic Cryochrepts, glaciated mountain ridges-----	64,397
57-9----	Andic Cryochrepts, glaciated mountain slopes-----	71,587
72-----	Cirqueland-Entic Cryandepts complex, very steep-----	148,452
73-----	Andic Cryochrepts-Andeptic Cryoboralfs association, glacial trough walls-----	190,077
74-----	Ochrepts, very steep-----	20,053
75-----	Rock outcrop, structural breaklands-----	26,558
76-----	Rock outcrop-Ochrepts complex, structural breaklands-----	79,674
77-----	Ochrepts-Rock outcrop complex, structural breaklands-----	19,759
78-----	Ochrepts-Rock outcrop complex, southerly aspects-----	30,956
	Total-----	1,613,290

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