

SOIL SURVEY OF

Cache Valley Area, Utah

Parts of Cache and Box Elder Counties



United States Department of Agriculture
Soil Conservation Service and Forest Service
In cooperation with
Utah Agricultural Experiment Station

Issued November 1974

Major fieldwork for this soil survey was done in the period of 1959-64. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Utah Agricultural Experiment Station. It is part of the technical assistance furnished to the Blacksmith Fork and North Cache Soil Conservation Districts.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All the soils of the Cache Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site, woodland suitability group, and wildlife suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitations of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that

have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, range sites, and woodland suitability groups.

Foresters and others can refer to the section "Use of the Soils as Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the Cache Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About the Cache Area" and also at the beginning of the publication.

Cover: Sugar beets on Hendricks silt loam, 1 to 3 percent slopes. Wasatch Mountains are in the background.

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SOIL SURVEY OF CACHE VALLEY AREA, UTAH

PARTS OF CACHE AND BOX ELDER COUNTIES

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE AND FOREST SERVICE, IN COOPERATION WITH THE UTAH AGRICULTURAL EXPERIMENT STATION

THE CACHE VALLEY AREA: PARTS OF CACHE AND BOX ELDER COUNTIES (called the Cache Area in this soil survey) is in the northern part of Utah and consists of about 813 square miles or 520,162 acres. It includes all of Cache County except about 230,000 acres of the Cache National Forest in the northeastern part of the county. It also includes about 17,000 acres of Box Elder County on the west slopes of Clarkston and Wellsville Mountains (fig. 1).

This is an important farming area. It consists of about 123,000 acres of irrigated cropland, 116,525 acres of non-irrigated cropland or pasture, and 280,802 acres of range and woodland.

Cache County consists essentially of Cache Valley and its surrounding drainage area. Geologically, the valley is a graben at the eastern margin of the Basin and Range province between the northernmost element of the Wasatch Range, Wellsville Mountain, and the southern extension of the Malad Range. Clarkston Mountain is on the west, and the Bear River Range is on the east (12).¹

The major part of the Cache Valley is at elevations between 4,400 and 5,200 feet. Height of the mountains included in the survey area ranges to nearly 10,000 feet.

The Bear River is the largest stream flowing into the survey area. It enters the valley from Idaho, west of Lewiston, Utah, runs south to the vicinity of Benson, then west into Box Elder County and into Great Salt Lake. The source of the Logan River is in the Franklin Basin. The Logan River enters Cache Valley east of the city of Logan. The source of the Little Bear River is in the extreme southern end of the county. The Blacksmith Fork River and its tributaries drain a large area from the east and southeast. Other smaller streams head in the mountains that border Cache Valley. The Bear River serves as a drainage for all these streams before it leaves Cache Valley toward Great Salt Lake. Most of the streams have cut deep channels through the lake terraces.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Cache Area, where they are located, and how they can be used. The soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the

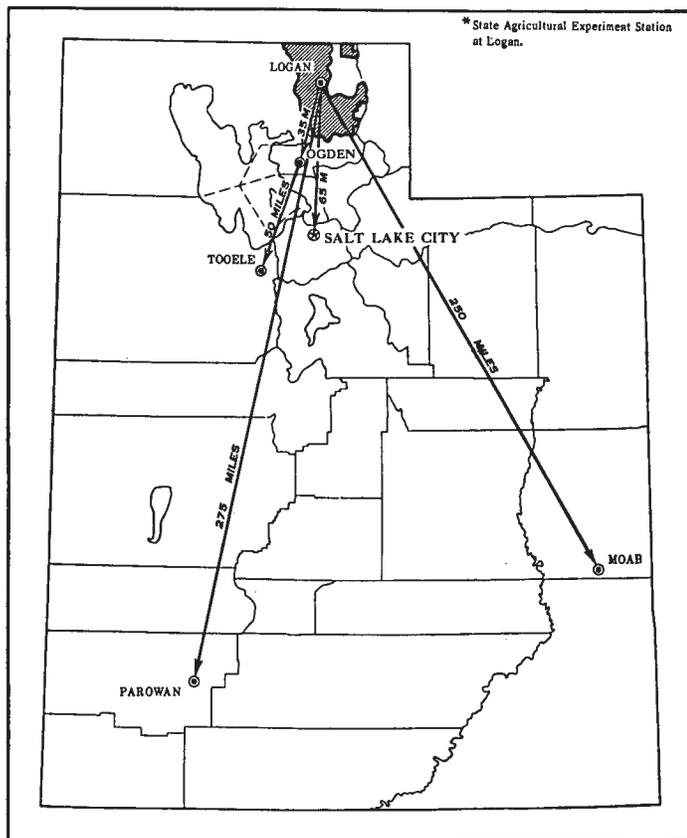


Figure 1.—Location of the Cache Valley Area in Utah.

¹ Italic numbers in parentheses refer to Literature Cited, p. 190.

soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in areas nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soils series* and the *soil phase* (8) are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Logan and Mendon, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Trenton silty clay loam, 2 to 4 percent slopes, is one of several phases within the Trenton series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of the Cache Area: soil complexes and soil associations.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. An example is Airport-Salt Lake complex.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort needed for mapping them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but

the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Agassiz-Goring association is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Mixed alluvial land is a land type in the Cache Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Cache Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The 14 soil associations in the Cache Area are discussed in the following pages. For more detailed information about the individual soils in each association, refer to the detailed map and to the section "Descriptions of the Soils."

Moderately Well Drained to Poorly Drained Soils of the Low Lake Terraces

Soils of this group are moderately well drained to poorly drained, but they are dominantly somewhat poorly drained and poorly drained. They formed in mixed lake sediment and alluvium derived mainly from limestone, sandstone, and quartzite. These soils have a loam to silty clay subsoil. They are nearly level or gently sloping (slopes range from 0 to 3 percent) and are on low lake terraces and alluvial fans at elevations of 4,420 to 4,700 feet. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days.

Three of the associations in the Cache Area are in this group. They make up about 18 percent of the survey area.

1. Logan-Salt Lake association

Poorly drained, nearly level soils that have a silty clay loam and silty clay underlying layer

This association consists of soils on valley bottoms. It extends from southeast of Mendon to a point west of the city of Logan and southwest of Smithfield. The association makes up about 4 percent of the survey area.

Logan soils occupy about 40 percent of the association, and Salt Lake soils about 30 percent. Airport, Greenson, Cardon, and Collett soils and Salt Lake, gypsum variant, soils occupy the remaining 30 percent.

The Logan soils are poorly drained or very poorly drained, and they are strongly calcareous. The surface layer is silty clay loam that is black or very dark gray when moist. The material underlying the surface layer is silty clay loam and silty clay. The Salt Lake soils are poorly drained or very poorly drained, and they are very strongly calcareous. The surface layer is silty clay that is black or very dark gray when moist. The material underlying the surface layer is silty clay. The Airport, Collett, and Greenson soils generally are on slightly higher terraces than the other soils.

The soils of this association are used mainly for native pasture or for meadow from which hay is cut. The vegetation is mostly sedges, wiregrass, foxtail, and saltgrass. In the swales, where the water table is highest, there are cattails and bulrushes.

2. Trenton association

Strongly saline and alkali, somewhat poorly drained and moderately well drained, nearly level to sloping soils that have a silty clay subsoil.

This association is located in two areas. One of these is between the town of Richmond and the Bear River. The other area is between the towns of Benson and Petersboro, north nearly to the town of Trenton, with a narrow arm that extends as far as Cornish. The association makes up about 6 percent of the survey area.

Trenton soils are dominant in this association and occupy about 80 percent of the association. Cache, Jordan, Payson, and Lasil soils make up the remaining 20 percent. These soils generally are on lower terraces than the Trenton soils.

The Trenton soils are somewhat poorly drained and moderately well drained, and they are strongly affected by salt and alkali. The surface layer is silty clay loam, and the subsoil is silty clay.

Most areas of the Trenton soils in this association are cultivated. When irrigation water is available, alfalfa, small grain, sugar beets, and improved pasture are important crops. Dryland areas are used for alfalfa and small grain. Where these soils are not cultivated, the vegetation consists mainly of saltgrass, alkali sacaton, western wheatgrass, Great Basin wildrye, gumweed, sagebrush, and greasewood.

3. Greenson-Nibley-Collett association

Dominantly somewhat poorly drained, nearly level to gently sloping soils that have a loam to silty clay subsoil or underlying layer

This association is in areas near the towns of Wellsville, College Ward, and Hyrum and in a narrow band west of the cities of Logan, Smithfield, and Richmond that extends to the Idaho line. The association makes up about 8 percent of the survey area.

Greenson soils occupy about 40 percent of this association, Nibley soils about 30 percent, and Collett soils about 15 percent. Roshe Springs and Millville soils occupy the remaining 15 percent.

The Greenson soils are somewhat poorly drained and moderately well drained. They are loam or silt loam throughout. The Nibley and Collett soils are somewhat poorly drained. They have a silty clay loam surface layer and a heavy silty clay loam and silty clay subsoil.

The soils of this association are used mainly for irrigated crops of alfalfa, small grain, corn for silage, sugar beets, and improved pasture. Small areas are used for dryland crops of alfalfa and small grain. Where these soils are adequately drained, they are well suited to crops. Where the soils are not cultivated, the vegetation consists mainly of western wheatgrass, saltgrass, foxtail, alkali sacaton, and some areas of sedges and wiregrass.

Well-drained to Somewhat Poorly Drained Soils of the Medium Lake Terraces

Soils of this group are dominantly moderately well drained and somewhat poorly drained, but some are well drained. They have a fine sandy loam subsoil. These soils formed in mixed alluvium and lake sediment derived mainly from limestone, sandstone, and quartzite rocks. They are nearly level and gently sloping and are at elevations of 4,430 to 4,550 feet. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 50° F., and the frost-free season is 130 to 150 days.

Only one association in the Cache Area is in this group. It covers about 6 percent of the survey area.

4. Kidman-Lewiston association

Nearly level to gently sloping soils that are fine sandy loam throughout

This association is near the towns of Lewistown and Cornish and in the area south to the town of Benson. It makes up about 6 percent of the survey area.

Kidman soils occupy about 45 percent of the association, and Lewiston soils about 35 percent. Quinney, Layton, and Preston soils occupy the remaining 20 percent.

The Kidman soils are moderately well drained and well drained. The surface layer and subsoil are fine sandy loam. The Lewiston soils are somewhat poorly drained. The texture is fine sandy loam throughout. The water table is at a depth of about 20 to 40 inches. The subsoil and substratum of the Lewiston soils are strongly affected by salt and alkali.

The soils in this association are used for irrigated crops of alfalfa, small grain, sugar beets, corn for silage, and improved pasture. When the water table is controlled, these soils are well suited to crops. Where the soils are not cultivated, the vegetation consists mainly of bluebunch wheatgrass, western wheatgrass, foxtail, saltgrass, and sagebrush.

Well-drained Soils of the Medium and High Lake Terraces

Soils of this group are dominantly well drained and have a loam to silty clay subsoil. These soils are nearly level to very steep and occupy lake terraces, alluvial fans, deltas, and terrace escarpments. The Mendon, Avon, Wheelon, and Collinston soils formed in material derived from the Salt Lake geologic formation and contain an appreciable amount of volcanic ash. The Ricks, Timpanogos, Parleys, and McMurdie soils formed in mixed alluvium and lake sediment derived mainly from limestone, quartzite, and sandstone. Elevation ranges from about 4,500 to 5,300 feet. The average annual precipitation is 15 to 20 inches, the mean annual air temperature is 45° to 50° F., and the frost-free season is 110 to 160 days.

Three of the associations in the Cache Area are in this group. They make up about 19 percent of the survey area.

5. Mendon-Avon association

Nearly level to strongly sloping soils that have a clay loam and silty clay subsoil

This association is in three separate areas. The largest of these is near the towns of Clarkston and Newton and extends south to Mendon. Another area is located south of Hyrum Dam, and a third is in the vicinity of the city of Richmond. The association makes up about 8 percent of the survey area.

Mendon soils occupy about 50 percent of the association, and Avon soils occupy about 30 percent. Crookston and Collinston soils, and small areas of Hyrum and Blackrock soils, make up the remaining 20 percent.

All of these soils formed in reworked lake sediment derived from rocks of the Salt Lake Formation. In most places the surface layer is black or dark gray when moist. The Mendon soils are well drained. They have a silt loam surface layer and a clay loam subsoil. Avon soils also are well drained. They have a silty clay loam surface layer and a silty clay subsoil.

The soils of this association are used mainly for non-irrigated crops, but near the towns of Newton, Mendon, and Richmond, much of the acreage is irrigated. The

irrigated crops are alfalfa, sugar beets, barley, wheat, corn for silage, and pasture. Where these soils are not cultivated, the vegetation consists mainly of western wheatgrass, bluebunch wheatgrass, balsamroot, and big sagebrush.

6. Wheelon-Collinston association

Moderately steep to very steep soils that have a loam, silt loam, and clay loam underlying layer

This association is in two areas. The major one of these is between the towns of Cornish and Clarkston and extends north to the Idaho line. The other area is a narrow band on the extreme west side of the Cache Valley from Clarkston south to the town of Mendon. This association makes up about 4 percent of the survey area.

Wheelon and Collinston soils are about equal in extent and occupy 85 percent of the association. Mendon, Munk and Blackrock soils make up the remaining 15 percent.

The Wheelon soils are well drained, and they are strongly calcareous. The silt loam surface layer is light olive brown when moist. The subsoil is silt loam. The Collinston soils are well drained, and they are strongly calcareous. The silt loam surface layer is dark gray when moist. The subsoil ranges from loam to clay.

The soils of this association are better suited to range than to cultivated crops. They are suitable for reseeding to adapted grasses. Some of the more gently sloping areas are suited to dryfarmed crops. The vegetation consists mainly of bluebunch wheatgrass, prairie junegrass, Great Basin wildrye, balsamroot, aster, buckwheat, geranium, and sagebrush.

7. Ricks-Timpanogos-Parleys association

Nearly level and strongly sloping soils that have a gravelly loam, gravelly sandy loam, loam, and clay loam subsoil

This association consists of soils in a narrow band, 2 to 3 miles wide, that extends from the town of Paradise on the south, through the cities of Hyrum, Logan, and Smithfield, and north to the Idaho line. The association occupies about 7 percent of the survey area.

Ricks and Timpanogos soils each occupy about 25 percent of the association, and Parleys and McMurdie soils each occupy about 15 percent. Sterling, Steed, Green Canyon, and Hillfield soils make up the remaining 20 percent.

The Ricks soils are mainly on old river deltas and terraces. They are well drained to somewhat excessively drained. The surface layer is gravelly loam, and the subsoil is sandy loam and gravelly loam. The substratum is very gravelly sand. The Timpanogos soils are well drained. The surface layer is silt loam, and the subsoil is loam. The Parleys soils are well drained and have a silt loam surface layer and a dominantly clay loam subsoil.

The soils of this association are used mostly for cultivated crops. Most areas are irrigated and are used for alfalfa, small grain, corn, peas, beans, orchards, and improved pasture. Nonirrigated areas are used for alfalfa and small grain. Where these soils are not cultivated, the vegetation is mainly bluebunch wheatgrass, balsamroot, buckwheat, and sagebrush.

Well-drained Soils of the Uplands

This group consists of two soil associations. The soils in these associations are similar in drainage and general location, but they have some contrasting soil characteristics and vary somewhat in position and climate.

The Nebeker-Hendrick association consists of well-drained soils that have a silty clay loam and clay subsoil. The soils are mainly strongly sloping to moderately steep and are on broad alluvial fans above the upper lake terraces. Elevation ranges from 4,800 to 5,700 feet. These soils formed in alluvium and colluvium derived chiefly from sandstone and quartzite rocks. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 110 to 140 days.

The Richmond-Sterling-Picayune association consists of somewhat excessively drained very gravelly and stony loams and sandy loams. These soils are on very steep terrace escarpments, deltas, and foot slopes of mountains. Elevation ranges from 5,200 to 7,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 42° to 48° F., and the frost-free season is 90 to 120 days.

The associations in this group make up about 11 percent of the survey area.

8. Nebeker-Hendricks association

Strongly sloping to moderately steep soils that have a silty clay loam or clay subsoil

This association consists of soils in six areas: (1) northwest of the town of Clarkston, (2) west and south from the town of Mendon, (3) the Dry Lake area, (4) east of the towns of Paradise and Avon, (5) east of the town of Hyde Park, and (6) east and south from the city of Richmond. The association occupies about 6 percent of the survey area.

Nebeker and Hendricks soils are about equal in extent and together make up about 70 percent of this association, and Crowshaw, Hiibner, Hyrum, and Obray soils occupy the remaining 30 percent.

The Nebeker and Hendricks soils are well drained and have a surface layer of silt loam. The subsoil of the Nebeker soils is clay, and that of the Hendricks soils is silty clay loam.

The soils of this association are used mainly for non-irrigated crops of alfalfa and wheat, but some areas are used for range. The vegetation is mainly western wheatgrass, slender wheatgrass, prairie junegrass, balsamroot, yarrow, and big sagebrush.

9. Richmond-Sterling-Picayune association

Somewhat excessively drained soils that have gravelly loam or gravelly sandy loam underlying layers or a gravelly clay loam subsoil.

This association is in four areas: (1) the west slopes of Clarkston Mountains, (2) the west slope of the Wells-ville Mountains, (3) the west-facing slopes of the moun-

tains east of the cities of Richmond and Smithfield, and (4) the west-facing mountain slopes east of the towns of Paradise and Avon. The association occupies about 5 percent of the survey area.

Richmond soils occupy about 40 percent of this association, Sterling soils 25 percent, and Picayune soils about 15 percent. Outcrops of limestone rock and small areas of Nebeker soils make up the remaining 20 percent.

The Richmond soils are very steep and are on south- and west-facing mountains. They are somewhat excessively drained, and they are strongly calcareous to very strongly calcareous throughout the profile. The subsoil is very gravelly, cobbly, and stony loam. The Sterling soils are very steep and are on south- and west-facing mountains. They are somewhat excessively drained and are strongly calcareous to very strongly calcareous throughout the profile. The Picayune soils generally are in the north-facing areas of the association, but they also are in small pockets in other exposures. They are well drained. The surface layer is very dark grayish brown, noncalcareous gravelly loam. The subsoil is gravelly and cobbly clay loam.

The soils of this association are used for range, wildlife habitat, and watershed. The vegetation is chiefly big sagebrush, juniper, cheatgrass, bluebunch wheatgrass, western wheatgrass, Sandberg bluegrass, yarrow, balsamroot, and bitterbrush. Deer and other wildlife use the vegetation for grazing in winter and spring.

Well-drained and Somewhat Excessively Drained Soils of the Mountains

Soils of this group are dominantly well drained to somewhat excessively drained. The subsoil is very gravelly. These soils formed in residuum, colluvium, and alluvium derived mainly from sandstone or quartzite and some limestone and shale rocks. They are sloping to very steep and are on mountains and alluvial fans at ranges of 5,300 to 8,000 feet. The average annual precipitation is 20 to 30 inches, the mean annual air temperature is 38° to 47° F., and the frost-free season is 50 to 100 days.

Two of the associations in the Cache Area are in this group. They make up about 16 percent of the survey area.

10. Yeates Hollow-Ant Flat-Goring association

Sloping to very steep soils that have a silty clay, clay, and very cobbly clay subsoil

This association consists of sloping to very steep soils on mountains. These soils are in five areas. The major ones of these are the upper Little Bear River area and the Hardware Ranch-Ant Flat area. The smaller ones are the Strawberry Valley area, the Franklin Basin area, and an area east of the town of Cove near the Idaho line. The association makes up about 12 percent of the survey area.

Yeates Hollow soils occupy about 35 percent of the association, Ant Flat soils about 20 percent, and Goring soils 15 percent. LaPlatta and Obray soils occupy the remaining 30 percent.

All the major soils of this association are well drained. The Yeates Hollow soils have a surface layer of extremely stony loam and a subsoil of very cobbly and stony clay. In the Ant Flat soils, the surface layer is loam and the subsoil is clay. The Goring soils have a silt loam surface layer and a silty clay subsoil.

The soils of this association are used for range that is grazed by sheep and cattle and for watershed and wildlife habitat. The vegetation is mainly bluebunch wheatgrass, tall native bluegrass, Great Basin wildrye, prairie junegrass, Columbia needlegrass, yarrow, geranium, balsamroot, lupine, buckwheat, yellowbrush, bitterbrush, and big sagebrush.

11. Sheep Creek-Hoskin-Curtis Creek association

Steep and very steep soils that have a gravelly and cobbly loam to clay loam subsoil

This soil association is in three, long, narrow areas. The largest of these is in the mountain area east of Ant Flat. A second area is on the east slope of Clarkston Mountain, and a third is west and south of the town of Wellesville. Small areas of the association are included in other associations in the mountains and high mountains. The soils generally are on south- or west-facing mountains. The association occupies about 4 percent of the survey area.

Sheep Creek soils occupy about 35 percent of this association, Hoskin soils about 20 percent, and Curtis Creek soils about 15 percent. Agassiz, St. Marys, Bradshaw, and Smarts soils and rock outcrop make up the remaining 30 percent.

Sheep Creek soils are well drained. The surface layer is cobbly loam, and the subsoil is very cobbly clay loam. Hoskin soils are well drained to somewhat excessively drained. The surface layer is cobbly loam or gravelly loam, and the subsoil is very cobbly loam. Curtis Creek soils are well drained. The surface layer is loam or cobbly loam, and the subsoil is loam and sandy clay loam.

The soils of this association are used as range for grazing by sheep and cattle and for watershed and wildlife habitat. The vegetation is mainly bluebunch wheatgrass, tall native bluegrass, Sandberg bluegrass, Great Basin wildrye, yarrow, balsamroot, big sagebrush, bitterbrush, and yellowbrush. Big sagebrush, bluebunch wheatgrass, cheatgrass, and weeds now make up a large part of the plant cover in many areas.

Well-drained and Somewhat Excessively Drained Soils of the High Mountains

Soils of this group are dominantly well drained and somewhat excessively drained. They have a gravelly, cobbly, and stony clay loam subsoil. The Agassiz, Dateman, Bickmore, and Bradshaw soils in this group formed mainly in residuum from limestone. The Lucky Star and Cluff soils formed largely in residuum from sandstone and quartzite rocks. These moderately steep to very steep soils are on mountains at elevations of 5,500 to 9,000 feet. The average annual precipitation is 20 to 35 inches, and the mean annual air temperature is 36 to 45° F.

Three of the associations in the Cache Area are in this group. They make up about 30 percent of the survey area.

12. Agassiz association

Very steep, stony and rocky soils that are silt loam and stony silty clay loam throughout

This association is in five general areas. The two larger of these are in the southeastern part of the county. They are the James Peak and Sharp Mountain area and the East Fork area of the Little Bear River drainage. The smaller areas are north of Monte Cristo Peak, in the Blacksmith Fork Canyon west of Hardware Ranch, and in the Franklin Basin-Beaver Mountain area. The association occupies about 5 percent of the survey area.

Agassiz soils occupy about 70 percent of the association, rock outcrop about 10 percent, and Foxol soils about 6 percent. The Foxol soils are important, particularly in the James Peak area. Bradshaw and Elwood soils make up the remaining 14 percent.

The Agassiz soils are somewhat excessively drained and are very cobbly silt loam and silty clay loam throughout. The Agassiz soils dominantly face to the south or west and are intermingled with outcrops of limestone on ridges and escarpments.

The soils are used mainly for range that is grazed by sheep. Other uses are wildlife habitat and watershed. The vegetation is mainly big sagebrush, curleaf mountain-mahogany, bluebunch wheatgrass, buckwheat, snowberry, chokecherry, and some juniper.

13. Dateman-Agassiz-Bradshaw association

Steep and very steep soils that are cobbly or very cobbly silt loam and silty clay loam throughout or have a cobbly loam subsoil

This association is in the high mountains extending from the Blacksmith Fork River south to the vicinity of Sharp Mountain. The association occupies about 6 percent of the survey area.

Dateman and Agassiz soils each occupy about 35 percent of the association, and Bradshaw soils about 15 percent. Bickmore soils make up about 9 percent and rock outcrop about 6 percent of the remaining 15 percent.

The Dateman soils are well drained. They have a surface layer of very dark brown cobbly silt loam, and the subsoil is very cobbly silty clay loam. They have north-facing slopes, where the vegetation is conifers. The Agassiz soils are somewhat excessively drained. They are very cobbly silt loam and silty clay loam throughout. They are very steep in south- and west-facing areas in which there are outcrops and ledges of limestone. Bradshaw soils are well drained and have a cobbly loam subsoil. They are steep and very steep, and they are under a plant cover of grass and brush.

The soils of this association are used for range that is grazed mainly by sheep. Wildlife habitat and watershed are also important uses for these soils. The vegetation consists mainly of Douglas-fir and alpine fir on Dateman soils that have north-facing slopes, and bluebunch wheatgrass, Great Basin wildrye, ceanothus, serviceberry, big sagebrush, chokecherry, buckwheat, and bal-

samroot on other slopes. The trees are harvested for lumber in some areas of the Dateman-soils.

14. *Lucky Star-Cluff-Bickmore association*

Moderately steep and steep soils that have a very cobbly sandy clay loam, gravelly clay, or cobbly silty clay loam subsoil

This association is in eight large areas: (1) the east-facing slopes of Clarkston Mountains, (2) the east-facing slopes of the Wellsville Mountains, (3) the mountain slopes west of the Upper Little Bear River, (4) the upper areas of Hyrum and Paradise Dry Canyons, (5) the areas south of Sharp Mountain to the Weber County Line, (6) the Monte Cristo area joining the Box Elder County Line, (7) the Upper Curtis Creek-Rock Creek area, and (8) the Franklin Basin-Beaver Mountain area. This is the largest association in the survey area and makes up about 19 percent of the total acreage.

Lucky Star soils occupy about 35 percent of the association, Cluff soils 25 percent, and Bickmore soils about 15 percent. Elwood, Fitzgerald, Scout, Elzinga, Maughan, and Scave soils make up the remaining 25 percent.

The Lucky Star soils are deep and well drained and have a very cobbly sandy clay loam subsoil. They have north- and east-facing slopes, where the vegetation is aspen. The Cluff soils are well drained and have a gravelly clay subsoil. The vegetation on these soils is conifers. The Bickmore soils are well drained and have a cobbly silty clay loam subsoil. They are very steep and have north- and east-facing slopes. The vegetation on Bickmore soils also is conifers.

Soils in this association are used mainly for watershed, wildlife habitat, and range. In some areas Douglas-fir is used for timber and the understory is grazed by sheep. In the aspen stands, Douglas-fir and alpine fir grow as scattered trees or are in small clumps. At present, markets for aspen products are limited in the survey area and the aspen sites are grazed by sheep and cattle.

Descriptions of the Soils

This section describes the soil series and mapping units in the Cache Area. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains a brief description of a representative profile that is in terms familiar to the layman. A detailed description of the same profile is given as part of the description of the first mapping unit. This second profile description is in technical terms and is for scientists, engineers, and others who need to make thorough and

precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Mixed alluvial land, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, woodland group, and wildlife group in which the mapping unit has been placed. The page for the description of each of these groups can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (8).

A given soil series in the Cache Area may be identified by a different name in a recently published soil survey of an adjacent survey area. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soil series described in this Area are considered to be within the range defined for that series. In those instances where a soil series has one or more features outside the defined range, the differences are explained.

Agassiz Series

The Agassiz series consists of somewhat excessively drained, strongly sloping to very steep soils that formed in residuum derived from limestone. These soils occur mostly in mountainous areas at elevations of 5,500 to 8,500 feet. Their slopes face south and west and range from 6 to 70 percent. The annual precipitation is 20 to 35 inches, the mean annual air temperature is 36° to 42° F., and the frost-free season is 80 to 100 days. The vegetation is mainly big sagebrush, curlleaf mountain-mahogany, bluebunch wheatgrass, snowberry, serviceberry, chokecherry, and some juniper trees.

Agassiz soils are commonly associated with Goring, Mult, Elwood, Bradshaw, Dateman, Bickmore, and Lucky Star soils.

In a representative profile, the surface layer is about 18 inches thick and is brown very cobbly silt loam in the upper part and brown very cobbly silty clay loam in the lower part. It is neutral in reaction. Just below the surface layer is limestone bedrock. The upper 4 to 6 inches of the bedrock is fractured, and soil material has filled the cracks.

Agassiz soils are used for watershed, range, and wildlife habitat.

Agassiz rocky silt loam, 6 to 30 percent slopes (AAE).—This sloping to moderately steep soil is in mountainous areas and on ridges above lake terraces throughout the survey area. Rock outcrop covers 2 to 10 percent of the surface.

TABLE 1.—Approximate acreage and proportionate extent of each mapping unit

Mapping unit	Area		Mapping unit	Area	
	Acres	Percent		Acres	Percent
Agassiz rocky silt loam, 6 to 30 percent slopes	2,855	0.5	Flygare silt loam, 3 to 20 percent slopes	1,625	0.3
Agassiz rocky silt loam, 30 to 70 percent slopes, eroded	2,040	.4	Foxol rocky loam, 30 to 60 percent slopes	5,050	1.0
Agassiz-Bradshaw association, eroded	9,920	1.9	Goring silt loam, 6 to 30 percent slopes	5,495	1.1
Agassiz-Dateman association, eroded	15,555	2.9	Goring-Obray association, eroded	8,440	1.6
Agassiz-Elwood association, eroded	2,640	.5	Gravel pit	348	(1)
Agassiz-Goring association	1,590	.3	Green Canyon gravelly loam, 0 to 3 percent slopes	1,735	.3
Agassiz-Goring association, eroded	1,580	.3	Green Canyon gravelly loam, 3 to 7 percent slopes	440	(1)
Airport silt loam, 0 to 3 percent slopes	1,915	.4	Greenon loam, 0 to 3 percent slopes	13,070	2.5
Airport silty clay loam	1,540	.3	Greenon loam, 3 to 6 percent slopes	695	.1
Airport-Salt Lake complex	2,175	.4	Greenon loam, 6 to 10 percent slopes	235	(1)
Ant Flat loam, 6 to 20 percent slopes	7,360	1.4	Greenon loam, deep over clay, 0 to 1 percent slopes	413	(1)
Ant Flat-Despain association, eroded	5,925	1.1	Greenon loam, deep over gravel, 0 to 1 percent slopes	244	(1)
Avon silty clay loam, 0 to 3 percent slopes	3,440	.6	Hendricks silt loam, 1 to 3 percent slopes	546	.1
Avon silty clay loam, 3 to 6 percent slopes	2,000	.4	Hendricks silt loam, 3 to 6 percent slopes	725	.1
Avon silty clay loam, 6 to 10 percent slopes	1,035	.2	Hendricks silt loam, 6 to 10 percent slopes	1,560	.3
Avon silty clay loam, 10 to 20 percent slopes	625	.1	Hendricks silt loam, 10 to 20 percent slopes	2,335	.5
Avon-Collinston complex, 6 to 10 percent slopes	1,175	.2	Hiibner extremely stony clay loam, 1 to 30 percent slopes	1,480	.3
Avon-Collinston complex, 10 to 30 percent slopes	1,160	.2	Hiibner gravelly clay loam, 3 to 10 percent slopes	212	(1)
Barfuss-Leatham association	7,910	1.5	Hiibner gravelly clay loam, 10 to 20 percent slopes	305	(1)
Battle Creek silty clay loam, 0 to 2 percent slopes	1,650	.3	Hiibner gravelly clay loam, 20 to 30 percent slopes	205	(1)
Battle Creek silty clay loam, 8 to 15 percent slopes	565	.1	Hillfield silt loam, 20 to 30 percent slopes, eroded	285	(1)
Bickmore gravelly silt loam, 30 to 70 percent slopes	330	(1)	Hillfield-Timpanogos silt loams, 10 to 30 percent slopes, eroded	1,275	.3
Bickmore-Agassiz association, eroded	1,355	.3	Hoskin cobbly loam, 30 to 70 percent slopes, eroded	1,810	.4
Bickmore-Sheep Creek association, eroded	8,515	1.6	Hoskin-Datwyler association, eroded	625	.1
Blackrock extremely stony loam, 10 to 20 percent slopes	440	(1)	Hoskin-Elzinga association, eroded	1,495	.3
Blackrock gravelly loam, 3 to 6 percent slopes	235	(1)	Hoskin-Seave association	3,115	.6
Blackrock gravelly loam, 6 to 10 percent slopes	420	(1)	Hoskin-Scout association, eroded	4,210	.8
Blackrock gravelly loam, 10 to 20 percent slopes	495	(1)	Hoskin-Smarts association, eroded	910	.2
Bradshaw-Agassiz association, eroded	5,185	1.0	Hoskin gravelly loam, thick surface, 1 to 6 percent slopes	790	.1
Cache silty clay	1,560	.3	Hyrum gravelly loam, 4 to 8 percent slopes	465	(1)
Cardon silty clay	2,222	.4	Hyrum gravelly loam, 10 to 25 percent slopes	620	.1
Center Creek silt loam	356	(1)	Hyrum cobbly loam, 4 to 8 percent slopes	430	(1)
Clegg silt loam, 20 to 30 percent slopes	730	.2	Jordan silty clay loam	975	.2
Cluff silt loam, 6 to 30 percent slopes	1,190	.2	Jordan-Lasil silty clay loams	1,303	.3
Cluff-Lucky Star association	2,120	.4	Kidman fine sandy loam, 0 to 2 percent slopes	3,200	.6
Cluff-Scout association	4,035	.8	Kidman fine sandy loam, 8 to 15 percent slopes	225	(1)
Collett silty clay loam	5,890	1.1	Kidman fine sandy loam, deep water table, 0 to 2 percent slopes	8,310	1.6
Collinston loam, 1 to 6 percent slopes	815	.2	Kidman fine sandy loam, deep water table, 2 to 4 percent slopes	290	(1)
Collinston loam, 6 to 10 percent slopes	870	.2	Kidman fine sandy loam, deep water table, 4 to 8 percent slopes	545	.1
Collinston loam, 10 to 30 percent slopes, eroded	1,335	.3	Kirkham-Shay complex	1,180	.2
Collinston loamy fine sand, 0 to 3 percent slopes	433	(1)	Kirkham-Shay complex, strongly alkali	820	.2
Crookston loam, 0 to 3 percent slopes	3,355	.6	Lakewin gravelly coarse sandy loam	472	(1)
Crookston loam, 3 to 6 percent slopes	395	(1)	LaPlatta silty clay loam, 30 to 50 percent slopes	292	(1)
Crookston loam, 6 to 10 percent slopes	298	(1)	LaPlatta-Obray association	4,457	.9
Crowshaw gravelly loam, 3 to 6 percent slopes	285	(1)	Layton loamy fine sand	1,920	.4
Crowshaw gravelly loam, 6 to 10 percent slopes	1,065	.2	Leatham-Barfuss association, eroded	4,060	.8
Crowshaw gravelly loam, 10 to 20 percent slopes	700	.1	Lewiston fine sandy loam	8,790	1.7
Curtis Creek-Goring association, hilly	2,300	.5	Lewiston fine sandy loam, strongly alkali	480	(1)
Curtis Creek-Goring association, steep	1,710	.3	Logan silty clay loam	2,035	.4
Dagor silt loam, 4 to 8 percent slopes	305	(1)	Lucky Star silt loam, 6 to 30 percent slopes	5,900	1.1
Dagor silt loam, 10 to 20 percent slopes	455	(1)	Lucky Star gravelly silt loam, 30 to 60 percent slopes	14,930	2.9
Dateman-Bradshaw association	3,060	.6	Lucky Star-Goring association	4,460	.9
Dateman extremely rocky silt loam, 40 to 80 percent slopes	7,545	1.5	Lucky Star-Hoskin association	2,065	.4
Datwyler cobbly silty clay loam, 30 to 60 percent slopes	655	.1	Lucky Star-Red Spur complex, 6 to 30 percent slopes	1,185	.2
Datwyler-Elzinga-Maughan association	6,450	1.3			
Despain-Bickmore association	1,780	.3			
Despain-Lucky Star association	840	.2			
Elwood silt loam, 30 to 60 percent slopes	700	.1			
Elwood-Agassiz association	1,115	.2			
Elwood-Mult association, hilly	1,350	.3			
Elwood-Mult association, steep	4,500	.9			
Fitzgerald extremely stony loam, 10 to 20 percent slopes	3,040	.6			

See footnote at end of table.

TABLE 1.—Approximate acreage and proportionate extent of each mapping unit—Continued

Mapping unit	Area	Extent	Mapping unit	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Lucky Star-Scout association	2,595	0.5	St. Marys-Curtis Creek association	2,170	0.4
Maughan-Datwyler association	800	.1	Salt Lake silty clay	2,185	.4
McMurdie silt loam, 0 to 3 percent slopes	725	.1	Salt Lake silty clay loam	790	.2
McMurdie silt loam, 3 to 6 percent slopes	1,715	.4	Salt Lake-Logan complex	345	(¹)
McMurdie silt loam, 6 to 10 percent slopes	1,075	.2	Salt Lake-Roshe Springs complex	3,085	.6
McMurdie-Hillfield silt loams, 10 to 30 percent slopes, eroded	460	(¹)	Salt Lake-Trenton complex	520	.1
Mendon silt loam, 0 to 3 percent slopes	9,810	2.0	Scave extremely rocky silt loam, 10 to 30 percent slopes	720	.1
Mendon silt loam, 3 to 6 percent slopes	5,220	1.0	Scave silt loam, 10 to 30 percent slopes	2,005	.4
Mendon silt loam, 6 to 10 percent slopes	2,030	.4	Scout gravelly loam, 40 to 70 percent slopes	1,025	.2
Mendon-Collinston complex, 1 to 6 percent slopes	1,405	.3	Shay silty clay loam	355	(¹)
Mendon-Collinston complex, 6 to 30 percent slopes, eroded	4,970	1.0	Sheep Creek cobbly loam, 30 to 70 percent slopes, eroded	3,820	.7
Millville silt loam, 0 to 2 percent slopes	1,750	.3	Sheep Creek-Agassiz association, eroded	5,270	1.0
Millville silt loam, 2 to 4 percent slopes	860	.2	Sheep Creek-Despain association, eroded	2,225	.4
Mixed alluvial land	5,465	1.1	Sheep Creek-Maughan association, eroded	3,115	.6
Multi-Agassiz association	3,700	.7	Smarts silt loam, 10 to 30 percent slopes	1,150	.2
Multi-Agassiz association, eroded	1,050	.2	Smarts-Hoskin association, eroded	3,950	.8
Multi-Lucky Star association	640	.1	Smarts-Lucky Star-Poleline association	6,000	1.2
Munk-Blackrock gravelly loams, 30 to 70 percent slopes, eroded	2,830	.5	Steed gravelly loam, 0 to 3 percent slopes	2,620	.5
Nebeker silt loam, 3 to 6 percent slopes	405	(¹)	Steed gravelly loam, 3 to 6 percent slopes	706	.1
Nebeker silt loam, 6 to 10 percent slopes	840	.2	Steed gravelly loam, 6 to 10 percent slopes	890	.1
Nebeker silt loam, 10 to 25 percent slopes	4,600	.9	Sterling gravelly loam, 6 to 10 percent slopes	595	.1
Nibley silty clay loam, 0 to 3 percent slopes	7,160	1.4	Sterling gravelly loam, 10 to 20 percent slopes	2,895	.6
Nibley silty clay loam, 3 to 6 percent slopes	965	.2	Sterling gravelly loam, 20 to 50 percent slopes, eroded	3,170	.6
Obray silty clay, 1 to 6 percent slopes	210	(¹)	Stony alluvial land	815	.2
Parleys silt loam, 0 to 3 percent slopes	1,600	.3	Timpanogos silt loam, 0 to 3 percent slopes	2,000	.4
Parleys silt loam, 3 to 6 percent slopes	890	.2	Timpanogos silt loam; 3 to 6 percent slopes	910	.2
Parleys silt loam, 6 to 10 percent slopes	515	(¹)	Timpanogos silt loam, 6 to 10 percent slopes	845	.2
Parlo silt loam, 0 to 3 percent slopes	2,460	.5	Timpanogos silt loam, 10 to 20 percent slopes, eroded	360	(¹)
Parlo silt loam, 3 to 6 percent slopes	385	(¹)	Timpanogos silt loam, deep water table, 0 to 3 percent slopes	2,015	.4
Parlo silt loam, 6 to 10 percent slopes	165	(¹)	Trenton silty clay loam, 0 to 2 percent slopes	13,725	2.6
Payson silt loam	1,190	.2	Trenton silty clay loam, 2 to 4 percent slopes	260	(¹)
Picayune-Agassiz association, eroded	3,030	.6	Trenton silty clay loam, 4 to 8 percent slopes	430	(¹)
Picayune-Smarts association	905	.2	Trenton silty clay loam, 8 to 20 percent slopes, eroded	745	.1
Poleline-Agassiz association, eroded	1,790	.4	Trenton silty clay loam, moderately deep water table, 0 to 2 percent slopes	3,795	.7
Preston fine sand, 0 to 10 percent slopes	325	(¹)	Wheelon silt loam, 10 to 30 percent slopes	1,605	.3
Provo gravelly loam	750	.1	Wheelon silt loam, 30 to 50 percent slopes, eroded	3,720	.7
Provo loam	1,695	.3	Wheelon-Collinston complex, 10 to 30 percent slopes, eroded	9,400	1.8
Quinney silt loam	2,345	.5	Winn silt loam	2,290	.4
Richmond very stony loam, 30 to 70 percent slopes, eroded	2,790	.5	Winn-Provo complex	1,250	.2
Richmond-Middle association, eroded	5,550	1.1	Woods Cross silty clay loam	205	(¹)
Richmond-Munk association, eroded	815	.2	Yeates Hollow extremely stony silty clay loam, 3 to 30 percent slopes, eroded	8,110	1.6
Richmond-Nebeker association, eroded	3,970	.8	Yeates Hollow extremely rocky silt loam, 6 to 30 percent slopes	5,410	1.0
Richmond-Sterling association, eroded	2,415	.5	Yeates Hollow extremely rocky silt loam, 30 to 70 percent slopes	4,080	.8
Ricks gravelly loam, 0 to 3 percent slopes	5,025	1.0			
Ricks gravelly loam, 3 to 6 percent slopes	1,545	.3			
Ricks gravelly loam, 6 to 10 percent slopes	965	.2			
Riverwash	260	(¹)			
Rock land	15,215	2.9			
Roshe Springs silt loam	2,735	.5			
Rough broken land	3,160	.6			
St. Marys gravelly very fine sandy loam, 30 to 60 percent slopes	645	.1			
			Total	520,162	100.0

¹ Less than 0.1 percent.

Representative profile, located 1,200 feet north and 1,200 feet west of the SE. corner of sec. 19, T. 10 N., R. 3 E. (profile described between rock outcrops) :

A11—0 to 7 inches, brown (7.5YR 5/3) very cobbly silt loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; soft, very friable, nonsticky and slightly plastic; many fine and medium roots; neutral; clear, wavy boundary.

A12—7 to 18 inches, brown (7.5YR 5/3) very cobbly light silty clay loam, dark brown (7.5YR 3/3) when moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many, very fine, discontinuous, interstitial impeded pores; neutral; abrupt, broken boundary.

R—18 inches, fractured limestone bedrock (about 90 percent rock); soil material in cracks.

The A horizon ranges from brown or dark brown to grayish brown in the upper part; its hue is 10YR or 7.5YR. Its texture ranges from very cobbly silt loam or extremely stony silt loam to cobbly light silty clay loam. In some places the profile contains a C horizon. The lower part of the A horizon and the C horizon range from brown and dark brown to reddish brown; hue is dominantly 10YR and 7.5YR, but it is 5 YR in places. Texture ranges from very cobbly or channery silty clay loam to very cobbly heavy loam. Coarse fragments, mainly cobblestones and gravel-size or channery fragments of limestone, make up 20 to 60 percent, by volume, of the upper part of the A horizon and 50 to 80 percent of the lower part of the A horizon and the C horizon. Stones cover as much as 10 percent of the surface in places. Depth to limestone bedrock is 10 to 20 inches. Reaction is neutral or mildly alkaline, and this soil is noncalcareous or slightly calcareous.

Permeability is moderate, and this soil holds 2 to 3.5 inches of available water above the bedrock. Some roots penetrate the fractured limestone to a depth of 2 feet or more. Runoff is medium to rapid, and the hazard of erosion is slight to moderate.

This soil is used for range, watershed, and wildlife habitat. (Capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Agassiz rocky silt loam, 30 to 70 percent slopes, eroded (AAG2).—This steep or very steep soil is in mountainous areas and on ridges above lake terraces throughout the survey area. Runoff is rapid or very rapid. This soil is moderately eroded, and the hazard of further erosion is high or very high.

This soil is used for range, wildlife habitat, and watershed. (Capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Agassiz-Bradshaw association, eroded (30 to 70 percent slopes) (ABG2).—This mapping unit consists of steep or very steep soils, mainly in the mountainous areas between Davenport Creek and Blacksmith Fork Canyon but also in the vicinity of Franklin Basin. About 75 percent of the acreage is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and 20 percent is Bradshaw silt loam, 30 to 60 percent slopes.

The Agassiz soil is on the sides of mountains. It has slightly convex slopes that face south and west, and it is moderately eroded. The cover of vegetation is mainly big sagebrush, bluebunch wheatgrass, snowberry, and curleaf mountain-mahogany.

The Bradshaw soil occupies areas between spur ridges, and it is also on the sides of mountains. This soil has slightly concave slopes that face north and east. The

vegetation is mainly serviceberry, snowberry, big sagebrush, ceanothus, and bluebunch wheatgrass.

Included in mapping were areas of Elwood silt loam, 30 to 60 percent slopes, that have a cover of conifers. This included soil makes up about 5 percent of the total acreage in the mapping unit.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Agassiz soil is in capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site. Bradshaw soil is in capability unit VIIIs-M4, nonirrigated; Mountain Stony Loam range site. Neither soil is in a woodland suitability group; wildlife suitability group 3)

Agassiz-Dateman association, eroded (30 to 70 percent slopes) (ADG2).—Soils of this mapping unit are steep or very steep. They generally occur on Sharp Mountain in areas where spur ridges are common, and they also occupy areas that extend northward to Blacksmith Fork Canyon. About 55 percent of the mapping unit is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and 35 percent is Dateman cobbly silt loam, 40 to 70 percent slopes.

The Agassiz soil has slopes that face east and south. It is moderately eroded. The cover of vegetation is mainly sagebrush, scattered oak brush, maple, and perennial grasses.

The Dateman soil has slopes that face north. A representative profile for this soil is described under the Dateman series. The Dateman soil has a cover of Douglas-fir and alpine fir.

Included in mapping were areas of Bradshaw silt loam, 30 to 60 percent slopes, and of Mult silt loam, 30 to 50 percent slopes. Each of these included soils makes up about 5 percent of the total acreage in the mapping unit. They are in small basins or other concave areas. The Mult soil has a cover of aspen.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Agassiz soil is in capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3. Dateman soil is in capability unit VIIIs-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Agassiz-Elwood association, eroded (30 to 70 percent slopes) (AEG2).—This mapping unit consists of steep or very steep soils in mountainous areas of the Logan River drainage areas near Franklin Basin. Elevations range from 7,000 to 8,200 feet, and the annual precipitation is 24 to 30 inches. About 55 percent of the mapping unit is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and 35 percent is Elwood silt loam, 30 to 60 percent slopes.

The Agassiz soil is moderately eroded, and it has slopes that face south and west. The vegetation is mainly big sagebrush, perennial grasses, and forbs.

The Elwood soil has slopes that face north and east. Vegetation on this soil is mainly Douglas-fir and lodgepole pine.

Included in mapping were areas of Fitzgerald extremely stony loam, 10 to 20 percent slopes, and of Mult silt loam, 30 to 50 percent slopes. Each of these included soils makes up about 5 percent of the total acreage in the mapping unit. The Fitzgerald soil is mainly toward the

southern end of this predominantly limestone area, and it has slopes that face north. The Malt soil is in pockets and on the bottoms of draws and drainageways. It has a cover of aspen.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Agassiz soil is in capability unit VII_s-MX₃, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3. Elwood soil is in capability unit VII_e-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Agassiz-Goring association (6 to 30 percent slopes) (AGE).—This mapping unit is north of Hardware Ranch in mountainous areas characterized by a network of ridges and drainageways. The elevation ranges from 6,500 to 7,500 feet, and the annual precipitation is 22 to 26 inches. About 70 percent of the mapping unit is Agassiz rocky silt loam, 6 to 30 percent slopes, and 30 percent is Goring silt loam, 6 to 30 percent slopes.

The Agassiz soil is on mountain ridges and has slopes that face south and west. It contains slightly more rock outcrop than Agassiz rocky silt loam, 6 to 30 percent slopes. The cover of vegetation is mainly mountain-mahogany and other shrubs, grasses, and forbs.

The Goring soil has concave slopes and is in draws and drainageways. It has a cover of grasses and sagebrush on all aspects.

These soils are used for range, watershed, and wildlife habitat. (The Agassiz soil is in capability unit VII_s-MX₃, nonirrigated; Mountain Shallow Loam range site. The Goring soil is in capability unit VI_e-M, nonirrigated; Mountain Loam range site. Neither soil is in a woodland suitability group; wildlife suitability group 3)

Agassiz-Goring association, eroded (30 to 70 percent slopes) (AGG2).—This mapping unit is in mountainous areas characterized by alternate concave-convex slopes, mainly north of Porcupine Reservoir. The annual precipitation is 20 to 25 inches, and the elevation ranges from 5,500 to 6,500 feet. About 55 percent of the mapping unit is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and about 35 percent is Goring silt loam, 30 to 60 percent slopes.

The Agassiz soil has convex, south- and west-facing slopes and is on ridges and side slopes. It is moderately eroded and has common fragments of limestone the size of stones scattered on the surface. The cover of vegetation is mainly big sagebrush, juniper, and perennial grasses and forbs.

The Goring soil has concave, dominantly east- and north-facing slopes and has a cover of big sagebrush, perennial grasses, and scattered maple trees.

Included in mapping unit were areas of Elzinga silt loam, 30 to 60 percent slopes, and Sheep Creek cobbly loam, 30 to 70 percent slopes, eroded. Each of these included soils makes up about 5 percent of the total acreage of the mapping unit. The Elzinga soil is under dense stands of maple on east- and north-facing areas at the upper extremes of the elevation range for the mapping unit. The Steep Creek soil is under scattered shrubs and forbs at the lower elevation for the unit.

Soils of this mapping unit are used for rangeland, wildlife habitat, and watersheds. (The Agassiz soil is in capa-

bility unit VII_s-MX₃, nonirrigated; Mountain Shallow Loam range site. The Goring soil is in capability unit VII_e-M, nonirrigated; Mountain Loam range site. Neither soil is in a woodland suitability group; wildlife suitability group 3)

Airport Series

The Airport series consists of somewhat poorly drained and poorly drained, saline and alkali soils. These soils formed in mixed lake sediment, derived mainly from limestone and quartzite. They are on low lake terraces at elevations of 4,420 to 4,460 feet. Slopes range from 0 to 3 percent. The vegetation is mainly saltgrass, foxtail, alkali sacaton, greasewood, and pickleweed. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Airport soils are associated with Payson, Logan, and Salt Lake soils.

In a representative profile (fig. 2), the surface layer is gray, mildly alkaline silt loam about 4 inches thick. The subsoil, about 12 inches thick, is gray, moderately alkaline silty clay loam in the upper part and light brownish-gray, very strongly alkaline silty clay loam in the lower part. The substratum is light-gray silty clay loam in the upper part and light-gray silt loam in the lower part. It extends to a depth of 60 inches or more and is very strongly alkaline. Lime has accumulated in the lower part of the subsoil and in the substratum.

Airport soils are used mostly for unimproved meadow pasture. Some areas have been drained and reclaimed and are used for irrigated crops. Principal crops are alfalfa, barley, sugar beets, and improved pasture.

Airport silt loam, 0 to 3 percent slopes (AhA).—This soil is on low lake terraces near the Cache Valley bottom. The areas extend from northwest of the city of Logan to the Idaho line.

Representative profile, about 400 feet south and 1,100 feet west of the northeast corner of sec. 6, T. 12 N., R. 1 E.:

- A1—0 to 4 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, thin and medium, platy structure that parts to weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; strongly calcareous; mildly alkaline; clear, smooth boundary.
- B2t—4 to 11 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; very hard, firm, very sticky and very plastic; common fine roots; many fine pores; thin continuous clay films; moderately calcareous; moderately alkaline; clear, smooth boundary.
- B3ca—11 to 16 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure; very hard, firm, sticky and plastic; few fine roots; many fine pores; thin clay films in pores; strongly calcareous; very strongly alkaline; clear, smooth boundary.
- C1ca—16 to 25 inches, light-gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) when moist; massive; extremely hard, firm, sticky and plastic; many fine pores; very strongly calcareous; very strongly alkaline; clear, smooth boundary.
- C2—25 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; massive; hard, firm, sticky and plastic; many fine pores; common, medium, distinct, brownish-yellow (10 YR 6/6) mottles; very strongly calcareous; very strongly alkaline.



Figure 2.—Profile of Airport silt loam, 0 to 3 percent slopes. This soil has a light-colored layer of lime accumulation just below the subsoil.

The A1 horizon ranges from gray to dark gray to dark grayish brown in hues of 10YR and 2.5Y. It ranges from 4 to 11 inches in thickness. The B2t horizon ranges from gray to grayish brown or light brownish gray in hues of 10YR and 2.5Y. Structure most commonly is moderate to strong prismatic. The subsoil and the substratum are very strongly calcareous and are moderately alkaline to very strongly alkaline. Depth to a distinct horizon of carbonate accumulation ranges from 10 to 16 inches. The horizon of carbonate accumulation most commonly occurs in the lower part of the B horizon and extends into the C horizon. The content of exchangeable sodium generally is less than 15 percent in the A1 horizon; it ranges from 16 to 30 percent in the B2t horizon and from 35 to 95 percent in the C horizon. The C horizon ranges from light gray to light grayish brown or pale brown in hues of 10YR, 2.5Y, and 5Y. Its texture ranges mainly from silt loam to silty clay, but there are strata of sandy loam in places. The water table most commonly occurs at a depth of 24 to 36 inches, but it ranges from the surface to a depth of 40

inches. Distinct, brownish-yellow mottles commonly occur between depths of 20 and 40 inches.

This soil is moderately difficult to till. It is somewhat poorly drained. Permeability is slow or very slow in the subsoil and in the substratum. If this soil is drained and reclaimed, it holds 7 to 9 inches of available water to a depth of 5 feet. Plants commonly are shallow rooted because of the high concentrations of salt and alkali in the subsoil and the substratum. Runoff is slow to ponded, and the hazard of erosion is slight.

Included in mapping were small areas of soils that have a silty clay loam surface layer; small areas, generally bare, where the surface layer is strongly affected by alkali; and small areas of a ponded soil. Also included were areas of soils that contain a cemented hardpan.

This soil is used mainly for improved pasture. Drainage and reclamation are needed for cultivated crops. Tile or open drains have been installed in about 40 percent of the acreage. These drained and partly reclaimed areas are used for alfalfa, barley, sugar beets, corn for silage, and improved pasture. Maintaining the level of the water table and the high concentration of salts below the depth reached by crop roots is necessary to sustain good production. (Capability unit IVw-28, irrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Airport silty clay loam (Ak).—This soil occurs at a slightly lower elevation than Airport silt loam, 0 to 3 percent slopes. It has a similar profile, however, except that the surface layer is silty clay loam and the subsoil and the substratum range to heavy silty clay loam. In places the water table is at or near the surface most of the time.

Included in mapping in the vicinity of Logan-Cache Airport were small tracts of a Payson silt loam that occupies areas $\frac{1}{2}$ foot to 2 feet above areas of this Airport soil. Also included were small areas of a soil that has a silt loam surface layer, small areas of a ponded soil, and small areas of a soil that is strongly affected by salt and alkali (slickspots).

About 25 percent of the acreage of this Airport soil is drained and is used for irrigated crops of alfalfa, barley, sugar beets, and corn for silage and for improved pasture. The remaining 75 percent is in native pasture. (Capability unit IVw-28, irrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Airport-Salt Lake complex (Am).—This complex consists of undulating soils on low lake terraces, mainly west and northwest of the city of Logan. About 60 percent of the complex is an Airport silt loam that has a shallow water table, and 40 percent is Salt Lake silty clay. Slopes are generally less than 1 percent.

The Airport soil is in irregularly shaped areas $\frac{1}{2}$ foot to 2 feet above areas of the Salt Lake soil. It has a water table at a depth of 10 to 20 inches most of the time. The Salt Lake soil is in long, narrow, interconnected depressions.

Included in mapping were small areas of soils where slopes are more than 1 percent. Also included were a few small areas of a ponded soil.

Most of the acreage is used as native pasture. A few areas are in improved pasture. (Capability unit IVw-28,

irrigated. Airport soil is in Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1. Salt Lake soil is in Wet Meadow range site; not in a woodland suitability group or in a wildlife suitability group)

Ant Flat Series

The Ant Flat series consists of well-drained soils that formed in residuum and colluvium derived from reddish Wasatch sandstone and shale. These soils are gently rolling or strongly sloping to steep and are in mountainous areas. The elevation ranges from 5,600 to 7,500 feet. Slopes range from 6 to 30 percent. The vegetation is dominantly bluebunch wheatgrass, tall native bluegrass, Idaho fescue, bitterbrush, big sagebrush, and snowberry. The average annual precipitation ranges from 20 to 26 inches, and the mean annual air temperature is 38° to 40° F. The frost-free season is 80 to 100 days. The Ant Flat soils are most commonly associated with Goring, Yeates Hollow, Hoskins and Despain soils.

In a representative profile, the surface layer is brown to dark-brown, slightly acid loam about 7 inches thick. The upper part of the subsoil is dark reddish-gray, yellowish-red, and red, neutral clay loam about 25 inches thick. The lower part of the subsoil, to a depth of 60 inches or more, is reddish-yellow, neutral clay loam and is strongly calcareous. Carbonates have been leached from the surface layer and upper part of the subsoil and redeposited in the lower part of the subsoil.

Ant Flat soils are used almost entirely for range, watershed, and wildlife habitat. Some areas were formerly dry-farmed, but most of these are now seeded to grasses.

Ant Flat Loam, 6 to 20 percent slopes (AND).—This moderately sloping to moderately steep soil is on all aspects of mountains. It is mainly in the Ant Flat area south of Hardware Ranch.

Representative profile in a range area, 2½ miles south of Anderson Ranch headquarters, ¾ mile west of the road, near the north quarter corner of sec. 10, T. 9 N., R. 3 E.:

- A1—0 to 7 inches, brown to dark-brown (7.5YR 4/2) heavy loam, very dark brown (7.5YR 2/2) when moist; weak, fine, granular structure; soft, friable, nonsticky and slightly plastic; many fine and medium roots and a few large roots; slightly acid; clear, wavy boundary.
- B1 —7 to 11 inches, dark reddish-gray (5YR 4/2) light clay loam, dark reddish brown (5YR 2/3) when moist; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine and medium roots and a few large roots; many, very fine, discontinuous, random, tubular inped pores; few thin clay films on peds, continuous in pores; thin continuous organic stains; slightly acid; clear, wavy boundary.
- B21t—11 to 18 inches, yellowish-red (5YR 5/6) heavy clay loam, yellowish red (5YR 4/6) when moist; strong, medium, subangular blocky structure; extremely hard, very firm, sticky and very plastic; common fine and medium roots and a few large roots; many very fine and few fine, discontinuous, random, tubular inped pores; thin continuous clay films on peds and in pores; thin organic stains; 10 percent gravel; slightly calcareous, lime is nonindurated, laminar, and veined; neutral; clear, wavy boundary.
- B22t—18 to 32 inches, red (2.5YR 5/6) clay, dark red (2.5YR 3/6) when moist; weak, coarse, prismatic structure that parts to strong, coarse, subangular blocky struc-

ture; extremely hard, very firm, very sticky and very plastic; few fine and medium roots; few, very fine, and fine, discontinuous, random, tubular inped pores; thin continuous clay films in pores and on peds; cracks up to one-fourth inch wide in some places; moderately calcareous; lime is nonindurated, laminar, and veined; neutral; abrupt, wavy boundary.

B3ca—32 to 60 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) when moist; moderate, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine roots; many, fine, discontinuous, interstitial, exped pores; thin clay films on some ped faces and in some pores; strongly calcareous; lime is nonindurated, veined and flaky; neutral.

The thickness of the solum ranges from 24 to 48 inches. The depth to the layer of carbonate accumulation ranges from 18 to 36 inches. The A1 horizon ranges from brown to dark brown in a hue of 10YR or 7.5YR. Texture is dominantly loam but is marginal to silt loam in places. Reaction is slightly acid to neutral. Thickness of the A1 horizon ranges from 7 to 16 inches. The B2t horizon ranges from yellowish red or red to strong brown or reddish brown in a hue of 7.5YR, 5YR or 2.5YR. Texture ranges, from clay to heavy clay loam. Structure is weak to moderate, medium to coarse, prismatic and subangular blocky. Clay films are common to continuous, thin to moderately thick in pores and on some ped faces. Reaction ranges from slightly acid to mildly alkaline. The lower part of the B2t horizon is slightly calcareous to moderately calcareous. The B3ca horizon ranges from brown to red in a hue of 7.5YR, 5YR, or 2.5YR. Texture ranges from clay loam to light clay. Reaction is neutral to moderately alkaline. The B3ca horizon is moderately calcareous to strongly calcareous. In places a strongly calcareous Cca horizon is present. It has about the same colors as the B3ca horizon, but its texture ranges from clay loam to sandy loam.

This soil is fairly easy to till. Permeability is slow in the subsoil and moderately slow in the substratum. From 10 to 12 inches of available water is held to a depth of 5 feet. Plant roots penetrate to a depth of 4 feet or more. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Obray silty clay, 6 to 20 percent slopes, and Yeates Hollow extremely stony silty clay loam, 3 to 30 percent slopes, eroded.

This Ant Flat soil is used almost entirely for range. Some areas were formerly cultivated and used for dry-farming, but these are now mostly seeded to grasses. (Capability unit VIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Ant Flat-Despain association, eroded (6 to 30 percent slopes) (AOE2).—This association lies south of the Hardware Ranch near Ant Flat and extends southward to the Weber County line. About 55 percent of the mapping unit is Ant Flat clay loam, 6 to 30 percent slopes, eroded; 30 percent is Despain gravelly loam, 20 to 30 percent slopes; and about 15 percent is included soils.

The Ant Flat soil is strongly sloping to steep. It has a profile similar to the one described as representative for the series, but the surface layer is clay loam and the subsoil is clay and is at a depth of 5 to 11 inches. This soil is moderately eroded and is strongly calcareous at a depth of 7 to 28 inches. It is underlain by calcareous sandstone at a depth of 40 to 48 inches. The slopes are dominantly 6 to 20 percent, but they range up to 30 percent. Runoff is slow to medium, and the hazard of erosion is moderate. The vegetation is mainly low sagebrush, mulesear dock, Idaho fescue, bluebunch wheatgrass, and yellowbrush.

The Despain soil has a profile similar to the one described as representative for the Despain series, but bed-

rock is at a depth below 40 inches in some places. Runoff is medium, and the hazard of erosion is moderate. The vegetation is mainly big sagebrush, bluebunch wheatgrass, native bluegrass, serviceberry, and bitterbrush.

Included in mapping were areas of Goring clay loam, 3 to 30 percent slopes; Yeates Hollow extremely stony silty clay loam, 3 to 30 percent slopes, eroded; and an unidentified black clay.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Ant Flat soil is in capability unit VIe-M5, nonirrigated; Mountain Clay range site. Despain soil is in capability unit VIe-M, nonirrigated; Mountain Loam range site. Neither soil is in a woodland suitability group; both are in wildlife suitability group 3)

Avon Series

The Avon series consists of well-drained soils that formed in mixed lake sediment derived chiefly from light-colored tuffaceous sandstone and limestone of the Salt Lake Formation. These soils are on high terraces, mainly along the west side of Cache Valley but partly in a smaller area east of the city of Richmond. The elevation ranges from 4,600 to 5,100 feet. Slopes range from 0 to 20 percent. The vegetation is dominantly bluebunch wheatgrass, western wheatgrass, and big sagebrush. The average annual precipitation ranges from 17 to 20 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 110 to 140 days. Avon soils are associated with Collinston, Crookston, Mendon, and Wheelon soils.

In a representative profile, the surface layer and the upper part of the subsoil are dark-gray, neutral silty clay loam. The combined thickness of the surface layer and the upper part of the subsoil is 12 inches. The lower part of the subsoil is dark-gray and dark grayish-brown, mildly alkaline silty clay about 15 inches thick. The substratum, to a depth of 60 inches or more, is light-gray, moderately alkaline silt loam or silty clay loam. Carbonates have been leached from the surface layer and the subsoil and redeposited in the substratum.

Avon soils are used mainly for dryfarmed crops, but some areas are irrigated.

Avon silty clay loam, 0 to 3 percent slopes (ArA).—This soil is on high lake terraces along the west side of Cache Valley.

Representative profile, located northeast of the city of Richmond, 800 feet west of the south quarter corner of sec. 13, T. 14 N., R. 1 E.:

- A1—0 to 9 inches, very dark gray (10YR 3/1) light silty clay loam, black (10YR 2/1) when moist; moderate, medium, granular structure; slightly hard, friable, sticky and slightly plastic; many fine and medium roots; common, fine and medium, discontinuous, random, interstitial pores; neutral; clear, wavy boundary.
- B1—9 to 12 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, medium prismatic structure that parts to moderate, fine, angular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; few thin clay films in pores; neutral; clear, wavy boundary.
- B2t—12 to 18 inches, dark-gray (10YR 4/1) light silty clay, very dark gray (10YR 3/1) when moist; weak, medium, prismatic structure that parts to moderate medium angular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; common, fine, dis-

continuous, random, interstitial pores; common thin clay films in pores and on some peds; noncalcareous; mildly alkaline; clear, smooth boundary.

B2t—18 to 27 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that parts to strong, medium, angular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; common, fine, discontinuous, random, interstitial pores; many thin clay films on ped faces and in pores; noncalcareous; mildly alkaline; clear, smooth boundary.

Cca—27 to 34 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, medium, sub-angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very strongly calcareous; lime is nonindurated, massive, veined, and flaky; moderately alkaline; clear, smooth boundary.

C—34 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, friable, nonsticky and nonplastic; strongly calcareous, lime is nonindurated and massive; moderately alkaline.

The combined thickness of the A1, B1, and B2t horizons ranges from 24 to 41 inches over the lime accumulation. In places the A1 horizon is slightly calcareous because this soil has received overwash of strongly calcareous, eroded material from higher areas. In places small amounts of gravel and cobbles are scattered on the surface and throughout the profile. Color of the A1 horizon ranges from very dark gray to dark gray. Texture ranges from silty clay loam to silt loam, and reaction is slightly acid to mildly alkaline. Thickness ranges from 9 to 15 inches. The transitional B1 horizon is present in most areas but is lacking in some. The B2t horizon ranges from dark grayish brown or dark gray to light brownish gray or light olive brown in a hue of 10YR or 2.5Y. Texture ranges from silty clay or clay to heavy silty clay loam. Structure ranges from weak to strong, and reaction is slightly acid to mildly alkaline. Thickness ranges from 12 to 26 inches. The C horizon ranges from light gray to white or pale yellow in a hue of 10YR, 2.5Y, or 5Y. Texture ranges from silty clay loam to silt loam, and in places this horizon is 10 to 40 percent unweathered tuffaceous gravel and cobbles below a depth of 40 inches. The calcium carbonate equivalent in the lime horizon ranges from 15 to 40 percent.

The surface layer is easy to work. Permeability is moderately slow. Runoff is slow, and the hazard of erosion is slight. This soil holds 10 to 12 inches of available water. Roots penetrate to a depth of 5 feet or more.

Included in mapping were small areas of a soil that has a silt loam surface layer, and areas of a soil that has slopes of 3 to 6 percent.

About 85 percent of the acreage of this Avon soil is used for dry farming, and the principal crops are wheat, alfalfa, and safflower. The remaining 15 percent is irrigated and is used for alfalfa and small grain. (Capability unit IIc-2, irrigated, and IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Avon silty clay loam, 3 to 6 percent slopes (ArB).—This soil is slightly undulating and is on high lake terraces, mainly along the west side of Cache Valley. It is associated with Avon silty clay loam, 0 to 3 percent slopes. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in mapping were small areas of a soil that has slopes of 1 to 3 percent and small areas of a soil that has slopes of 6 to 10 percent. Also included were small areas of Collinston loam, 1 to 6 percent slopes.

This Avon soil is used mostly for dryfarmed alfalfa and wheat. Some areas are used for irrigated small grain

and alfalfa. (Capability unit IIe-2, irrigated, and IIe-M, nonirrigated; not in a range site or woodland suitability group; wildlife suitability group 3)

Avon silty clay loam, 6 to 10 percent slopes (ArC).—This soil is on high lake terraces and escarpments, mainly along the west side of Cache Valley. It is similar to Avon silty clay loam, 0 to 3 percent slopes, except that it has slopes of 6 to 10 percent and the surface layer is 8 to 12 inches thick. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were a few small areas of Wheelon silt loam, 10 to 30 percent slopes, eroded, and small areas of Mendon silt loam, 6 to 10 percent slopes. Also included were a few areas of Avon soils that have slopes of 10 to 20 percent or of 3 to 6 percent.

This soil is used for dryfarmed winter wheat and alfalfa. (Capability unit IIIe-2, irrigated, and IIIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Avon silty clay loam, 10 to 20 percent slopes (ArD).—This soil has slopes that mainly face north or east. It is on lake terrace escarpments, mostly along the west side of Cache Valley. This soil is similar to Avon silty clay loam, 0 to 3 percent slopes, except that it is moderately eroded and the surface layer is only 8 to 10 inches thick. Runoff is medium to rapid, and the erosion hazard is moderate to high.

Included in mapping were small areas of Wheelon silt loam, 10 to 30 percent slopes, eroded, and small areas of Avon silty clay loam, 6 to 10 percent slopes.

This soil is used mostly for dryfarmed alfalfa and small grain. Some small areas are used for range. (Capability unit IVe-2, irrigated, and IVe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Avon-Collinston complex, 6 to 10 percent slopes (AsC).—This complex consists of gently rolling soils on high lake terraces along the west side of Cache Valley. About 70 percent of the complex is Avon silty clay loam, and 30 percent is Collinston loam. Runoff is medium, and the hazard of erosion is moderate.

The Avon soil is similar to Avon silty clay loam, 0 to 3 percent slopes, except that the surface layer is 8 to 10 inches thick. It has more gentle slopes than the Collinston soil, and its slopes face north.

The Collinston soil is similar to Collinston loam, 6 to 10 percent slopes, which is described under the Collinston series. It occupies the more exposed areas on ridges, and it has convex slopes that face south.

Included in mapping were areas of Wheelon silt loam, 10 to 30 percent slopes, eroded, and small areas of Collinston loam, 10 to 30 percent slopes.

Soils of this mapping unit are used for dryfarmed crops and for interspersed areas of range. Wheat, alfalfa, and safflower are the principal crops. (Capability unit IIIe-2, irrigated, IIIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Avon-Collinston complex, 10 to 30 percent slopes (AsE).—This mapping unit consists of rolling to hilly soils on terrace escarpments along the west side of Cache Valley. About 60 percent of the complex is Avon silty clay loam, 10 to 20 percent slopes, and about 40 percent is Collinston loam, 10 to 30 percent slopes, eroded. The

Avon soil is in the less sloping areas and has slopes that face north or east. The Collinston soil is on the more exposed, convex ridges and has slopes that face south or west.

The Avon soil is similar to Avon silty clay loam, 0 to 3 percent slopes, except that it is steeper and its surface layer is 7 to 8 inches thick.

The Collinston soil is similar to Collinston loam, 6 to 10 percent slopes, except that it is steeper and is moderately eroded. In places plowing has exposed the subsoil.

Included in mapping were areas of Wheelon silt loam, 10 to 30 percent slopes, eroded, and small areas of Collinston loam, 6 to 10 percent slopes.

Soils of this mapping unit are used for dryfarmed wheat and alfalfa and for interspersed areas of range. (Capability unit IVe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Barfuss Series

The Barfuss series consists of well-drained soils. These soils formed in residuum and colluvium derived from light-colored tuff, conglomerate tuffaceous sandstone, and limestone of the Salt Lake Formation. They contain a large amount of volcanic ash. These soils are on slightly concave foothills at elevations of 5,200 to 6,000 feet. Slopes range from 10 to 50 percent. The vegetation is dominantly bluebunch wheatgrass, Great Basin wildrye, native bluegrass, big sagebrush, bitterbrush, and serviceberry. The average annual precipitation ranges from 17 to 20 inches, and the mean annual air temperature is 42° to 45° F. The frost-free season is 80 to 110 days. Barfuss soils are associated with LaPlatta and Leatham soils.

In a representative profile, the surface layer is dark-gray, mildly alkaline silt loam about 10 inches thick. The subsoil is dark-gray and dark grayish-brown, moderately alkaline silty clay loam about 17 inches thick. The substratum, to a depth of 60 inches or more, is white, strongly alkaline silt loam.

Barfuss soils are used mainly for range, watershed, and wildlife habitat.

Barfuss-Leatham association (30 to 50 percent slopes) (BAF).—This mapping unit is mainly south and west of Avon and south of Clarkston, but a small area is on the north end of Wellsville Mountain. About 40 percent of the association is Barfuss silt loam, 30 to 50 percent slopes; 30 percent is Leatham silt loam, 30 to 50 percent slopes; 20 percent is LaPlatta silty clay loam, 30 to 50 percent slopes; and 10 percent is included soils.

The Barfuss soil has slopes that face north and east, and it is in mountainous areas. The vegetation is mainly western wheatgrass, big sagebrush, Sandberg bluegrass, yarrow, bluebunch wheatgrass, bitterbrush, and Great Basin wildrye.

The Leatham soil has slopes that face mainly south and west. It has a cover of cheatgrass, big sagebrush, bluebunch wheatgrass, bitterbrush, snakeweed, and yarrow.

The LaPlatta soil, like the Barfuss, has slopes that face north and east. It has a cover of bluebunch wheatgrass, big sagebrush, Great Basin wildrye, Sandberg bluegrass, and yarrow.

Representative profile of Barfuss silt loam, that has slopes of 30 to 50 percent, in an area of Barfuss-Leatham association, 1,200 feet south and 800 feet west of the northeast corner of sec. 8, T. 9 N., R. 1 E.:

- A1—0 to 10 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; moderately calcareous; mildly alkaline; clear, smooth boundary.
- B2t—10 to 19 inches, dark-gray (10YR 4/1) light silty clay loam, black (10YR 2/1) when moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; common, very fine and fine, discontinuous, random, vesicular pores; common thin clay films in pores and on some ped faces; moderately calcareous; moderately alkaline; clear, smooth boundary.
- B22t—19 to 27 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, fine, prismatic structure breaking to moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine roots and few medium roots; common, fine, discontinuous, random, vesicular pores; many thin clay films in pores and on ped surfaces; strongly calcareous, lime is nodular; moderately alkaline; gradual, smooth boundary.
- Cca—27 to 60 inches, white (2.5Y 8/1) silt loam, light brownish gray (2.5Y 6/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; very strongly calcareous; strongly alkaline.

The combined thickness of the A1 and Bt horizons ranges from 20 to 30 inches. The A1 horizon ranges from dark gray to gray. Texture is dominantly silt loam but is light silty clay loam in places. Reaction ranges from neutral to moderately alkaline, and the horizon is slightly to moderately calcareous. In places the profile contains a transitional, very dark gray B1 horizon. The B2t horizon ranges from dark gray to pale brown or light olive brown. Texture is dominantly clay loam or silty clay loam. Reaction is moderately alkaline to strongly alkaline, and the horizon is moderately to strongly calcareous. The Cca horizon ranges from white to pale brown or light gray in a hue of 10YR or 2.5Y. Texture is silt loam or heavy loam. The horizon is strongly or very strongly calcareous.

Permeability is moderately slow, and this soil holds from 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 4 feet or more. Runoff is rapid, and the hazard of erosion is high.

Included in mapping were areas of Wheelon silt loam, 30 to 50 percent slopes, eroded, and of O Bray silty clay, 6 to 20 percent slopes. The Wheelon soil is on ridges. It has convex slopes, and the O Bray soil has concave slopes. Both soils have slopes that face south and west.

Soils of this mapping unit are used mainly for range, watershed, and wildlife habitat. (Barfuss soil is in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site; not in a woodland suitability group; wildlife suitability group 3. Leatham soil is in capability unit VIIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Battle Creek Series

The Battle Creek series consists of well-drained soils. These soils formed in mixed lake sediment derived mainly from limestone, sandstone, and quartzite. They are on lake terraces at elevations of 4,475 to 4,600 feet. Slopes are 0 to 20 percent. The vegetation is dominantly

western wheatgrass, bluebunch wheatgrass, and big sagebrush. The average annual precipitation is 15 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 130 to 140 days. Battle Creek soils are mostly commonly associated with Parleys, McMurdie, Collett, Trenton, and Greenson soils.

In a representative profile, the surface layer is grayish-brown, neutral silty clay loam about 6 inches thick. The upper part of the subsoil is grayish-brown to brown, neutral to mildly alkaline silty clay about 13 inches thick. The lower part of the subsoil and the substratum are pinkish-gray, mildly to moderately alkaline silty clay to a depth of 60 inches or more. Carbonates have been leached from the surface layer and upper part of the subsoil and redeposited in the lower part of the subsoil and the substratum.

Battle Creek soils are used for irrigated and dryfarmed crops.

Battle Creek silty clay loam, 0 to 2 percent slopes (BcA).—This soil is on intermediate lake terraces of ancient Lake Bonneville. It is in the northeastern part of Cache Valley.

Representative profile, in a cultivated area 1 mile north and 1½ miles east of the Lewiston sugar factory, 200 feet south and 300 feet west of the northeast corner of sec. 2, T. 14 N., R. 1 E.:

- Ap—0 to 6 inches, grayish-brown (10YR 5/2) heavy silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure mixed with weak, medium, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; neutral; abrupt, smooth boundary.
- B1—6 to 10 inches, grayish-brown (10YR 5/2) silty clay, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular structure; hard, firm, sticky and plastic; few fine roots; few fine pores; neutral; clear, smooth boundary.
- B21t—10 to 13 inches, grayish-brown (10YR 5/2) silty clay, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure that parts to weak, fine, subangular blocky structure; very hard, firm, sticky and very plastic; few fine roots; common fine and few medium pores; common thin clay films; slightly calcareous; mildly alkaline; gradual, wavy boundary.
- B22t—13 to 19 inches, brown (7.5YR 5/2) silty clay, dark brown (7.5YR 4/2) when moist; weak, medium, prismatic structure that parts to weak, medium, subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; many fine and few medium pores; common thin clay films; moderately calcareous; mildly alkaline; gradual, wavy boundary.
- B3ca—19 to 37 inches, pinkish-gray (7.5YR 6/2) silty clay, dark brown (7.5YR 4/2) when moist; weak, medium, prismatic structure that parts to weak, medium, subangular blocky structure; very hard, firm, sticky and very plastic; few fine roots; many fine pores; few thin clay films; strongly calcareous; mildly alkaline; gradual, wavy boundary.
- C1ca—37 to 43 inches, pinkish-gray (7.5YR 7/2) silty clay, brown (7.5YR 5/4) when moist; common, medium, faint, strong-brown (7.5YR 5/8) mottles; medium subangular blocky structure; extremely hard, firm, sticky and very plastic; few fine roots; many fine and few medium pores; strongly calcareous; moderately alkaline; gradual, wavy boundary.
- C2ca—43 to 72 inches, pinkish-gray (7.5YR 7/2) silty clay, brown (7.5YR 5/4) when moist; few, medium, faint, yellowish-brown (10YR 5/8) mottles; laminated lake sediments; extremely hard, very firm, sticky and very plastic; few fine roots; common fine pores; strongly calcareous; moderately alkaline.

The combined thickness of the A1, B1, and B2t horizons ranges from 12 to 24 inches over the horizon of carbonate accumulation. The A horizon ranges from grayish brown to brown in hues of 10YR or 7.5YR. Texture is dominantly silty clay loam but ranges to light silty clay. Reaction is neutral to mildly alkaline. This horizon generally is noncalcareous but is slightly calcareous in places because of rodent activity. Thickness ranges from 6 to 10 inches. The B2t horizon ranges from 8 to 16 inches in thickness. The carbonate accumulation most commonly is in the lower part of the B horizon and extends into the C horizon. The C horizon ranges from pinkish gray to light brown. Faint mottles commonly are present below a depth of about 30 inches.

This soil is moderately difficult to work, and soil compaction results if the soil is tilled when wet. Permeability is slow. This soil holds from 9 to 10 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more but commonly are concentrated at a depth of 2 or 3 feet. Runoff is slow, and the hazard of erosion is none to slight.

Included in mapping were small areas of Parleys silt loam, 0 to 3 percent slopes.

Most of the acreage is cultivated. About 60 percent of this acreage is dryfarmed, and 40 percent is irrigated. Where irrigation water is available, the principal crops are alfalfa, small grain, corn for silage, sugar beets, and pasture. (Capability unit IIIs-25, irrigated, IIIs-U5, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Battle Creek silty clay loam, 8 to 15 percent slopes (BcD).—This strongly sloping soil is along drainageways on intermediate lake terraces north and east of Richmond. It is similar Battle Creek silty clay loam, 0 to 2 percent slopes, except that it has slopes of 8 to 15 percent, its surface layer is 6 to 8 inches thick, and in places plowing has exposed the subsoil. Runoff is medium, and the erosion hazard is moderate.

Included in mapping were areas of Trenton silty clay loam, 2 to 4 percent slopes, and small areas where slopes are 15 to 20 percent.

This soil is used mostly for dryfarmed alfalfa and small grain. (Capability unit IVe-2, irrigated, IVe-U5, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Bickmore Series

The Bickmore series consists of well-drained soils that have a cobbly silty clay loam subsoil. These soils formed in residuum and colluvium derived from limestone. Bedrock is at a depth between 28 and 40 inches. These soils are 20 to 50 percent cobblestones and gravel-size, angular, limestone rock fragments throughout the profile. They are on mountains at elevations of 6,000 to 8,000 feet, and they have slopes that face north and east and range from 30 to 70 percent. The vegetation is dominantly Douglas-fir and alpine fir and an understory of mountain myrtle, snowberry, chokecherry, ceanothus, and grasses. Average annual precipitation is 25 to 30 inches, mean annual air temperature is 38° to 42° F., and mean soil temperature in summer is less than 59°. The frost-free season is 80 to 100 days. Bickmore soils are most commonly associated with Sheep Creek, Agassiz, Mult, and Picayune soils.

In a representative profile the surface layer is dark-brown to brown, slightly acid gravelly silt loam about 16 inches thick. The upper part of the subsoil is brown

or dark-brown, neutral cobbly silty clay loam about 8 inches thick. The lower part of the subsoil is pale-brown; strongly calcareous very cobbly silty clay loam. Carbonates have been leached from the surface layer and re-deposited to form a layer of lime above the bedrock.

Bickmore soils are used dominantly for watershed and wildlife habitat, but some areas are grazed or used for woodland.

Bickmore gravelly silt loam, 30 to 70 percent slopes (BGG).—This soil is on mountains and has slopes that face north and east. It is mostly in the South Cottonwood Canyon area or on the Wellsville Mountains, but it is also in the mountain areas south of Avon.

Representative profile, located in South Cottonwood Canyon, 800 feet south of the northwest corner of sec. 30, T. 10 N., R. 3 E.:

O1—4 to 1½ inches, fir needles.

O2—1½ inches to 0, partly decomposed fir needles.

A11—0 to 2 inches, dark-brown (10YR 3/3) gravelly silt loam, very dark grayish brown (10YR 3/3) gravelly silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; loose, very friable, nonsticky and slightly plastic; many fine and common fine and medium roots; 20 percent gravel; slightly acid; abrupt, wavy boundary.

A12—2 to 16 inches, dark-brown to brown (10YR 4/3) gravelly silt loam, dark brown (10YR 3/3) when moist; moderate, coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and common medium and large roots; 20 percent gravel; neutral; clear, broken boundary.

B2t—16 to 24 inches, dark-brown to brown (10YR 4/3) cobbly silty clay loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine and medium roots; common thin clay films on peds; 40 percent cobblestones; neutral; clear, irregular boundary.

B3ca—24 to 37 inches, pale-brown (10YR 6/3) very cobbly silty clay loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; slightly hard, firm, sticky and plastic; many fine and medium roots; few thin clay films on peds; 50 percent cobblestones; strongly calcareous; neutral; abrupt, discontinuous boundary.

R—37 inches, fractured limestone bedrock, about 90 percent rock with material similar to that of the B3ca horizon in the cracks.

The O horizon ranges from 2 to 4 inches in thickness. The combined thickness of the A1 and B2t horizons ranges from 18 to 36 inches. The A1 horizon has a hue of 10YR or 7.5YR. Texture is dominantly gravelly silt loam but is gravelly loam in places. From 15 to 50 percent of this horizon is gravel and cobblestones. Reaction is slightly acid to neutral. Thickness ranges from 13 to 16 inches. The B2t horizon ranges from brown or dark brown to pale brown in a hue of 10YR or 7.5YR. Texture is dominantly cobbly light silty clay loam or cobbly clay loam and 20 to 50 percent of the horizon is cobblestones and gravel. Reaction is medium acid to neutral. The B3ca horizon has the same colors and texture as the B2t horizon, except that the content of cobblestones and gravel ranges from 50 to 80 percent, by volume. Reaction ranges from neutral to moderately alkaline, and the soil is moderately calcareous to strongly calcareous.

Included in mapping were areas of Agassiz rocky silt loam, 30 to 70 percent slopes, eroded. This included soil makes up about 10 percent of the total acreage.

Permeability is moderate. This soil holds 4 to 6 inches of available water above the bedrock. Some plant roots extend into the cracks in the bedrock. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used entirely for watershed, woodland, range, and wildlife habitat. Some timber formerly was harvested; but now only a few trees are cut. (Capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Bickmore-Agassiz association, eroded (30 to 80 percent slopes) (BKG2).—This mapping unit consists of soils in somewhat dissected scarp areas on the west side of Clarkston Mountain. Elevation ranges from 5,500 to 7,500 feet. Average annual precipitation is 20 to 25 inches. About 40 percent of the association is Bickmore gravelly silt loam, 30 to 70 percent slopes; 30 percent is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded; and 20 percent is Picayune cobbly loam, 50 to 80 percent slopes. The other 10 percent is rock outcrop and minor soils.

The Bickmore soil is on the north-facing mountains under Douglas-fir and alpine fir. The Agassiz soil is on the sharp ridgetops in association with rock ledges and rock outcrop. The cover is shrubs and grass.

These soils are used entirely for watershed, range, and wildlife habitat. The wooded areas of Bickmore soils are inaccessible and are not used for wood products. (Bickmore soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3. The Picayune soil is in capability unit VIIe-M4, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Bickmore-Sheep Creek association, eroded (30 to 70 percent slopes) (BLG2).—This mapping unit is in the Little Bear River drainage area in the vicinity of Three-Mile Canyon and Public Grove Hollow. About 40 percent of it is Bickmore gravelly silt loam, 30 to 60 percent slopes; 30 percent is Sheep Creek cobbly loam, 30 to 70 percent slopes, eroded; 20 percent is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded; and about 10 percent is included soils.

The Bickmore soil is on north-facing mountain areas under a cover of Douglas-fir and alpine fir. The Sheep Creek soil is on the lower part of south-facing mountain areas under a cover of sagebrush, bluebunch wheatgrass, bitterbrush, cheatgrass, and tall bluegrass. The Agassiz soil is on the upper part of south-facing mountain areas and convex ridges under a cover of curlleaf mountain-mahogany, bluebunch wheatgrass, sagebrush, and Oregon grape.

Included in mapping were areas of a deep, well-drained, fine-textured soil and a deep, well-drained loam.

Soils of this mapping unit are used entirely for range, watershed, and wildlife habitat. The areas of Bickmore soils are nearly inaccessible, and few trees have been cut. (Bickmore soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4. Sheep Creek soil is in capability unit VIIe-M4 nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Blackrock Series

The Blackrock series consists of well-drained soils that have a gravelly loam subsoil. These soils formed in mixed alluvium and colluvium derived from light-colored tuff, tuffaceous sandstone, and limestone. They are on alluvial fans and rolling foothills. These foothill areas are known locally as Newton Hill, Bergeson Hill, and Blackrock and Round Mountains. Elevations range from 4,600 to 5,700 feet, and slopes are 3 to 70 percent. The vegetation is mainly big sagebrush, bitterbrush, bluebunch wheatgrass, Great Basin wildrye, and cheatgrass. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the average frost-free season is 120 to 140 days. Blackrock soils are most commonly associated with Munk, Collinston, Mendon, and Wheelon soils.

In a representative profile, the surface layer is dark-gray, neutral gravelly loam about 22 inches thick. Below this is a layer of grayish-brown, neutral gravelly heavy loam about 17 inches thick. Between depths of 39 and 60 inches is light-gray, mildly alkaline, strongly calcareous gravelly clay loam.

Blackrock soils are used mainly for range, but some areas are used for dryland crops of alfalfa and small grain.

Blackrock gravelly loam, 10 to 20 percent slopes (BmD).—This soil is on foot slopes of Newton Hill, Bergeson Hill, and Blackrock and Round Mountains. It is mainly associated with Munk gravelly loam, 30 to 70 percent slopes.

Representative profile, located 2½ miles southwest of Trenton, 200 feet south and 800 feet east of the northeast corner of the southeast quarter of sec. 9, T. 13 N., R. 1 W.:

- A11—0 to 8 inches, dark-gray (10YR 4/1) gravelly loam, black (10YR 2/1) when moist; moderate, medium, granular structure; hard, friable, slightly sticky and slightly plastic; many fine, medium, and large roots; common medium pores; about 30 percent gravel; neutral; clear, smooth boundary.
- A12—8 to 22 inches, dark-gray (10YR 4/1) gravelly heavy loam, black (10YR 2/1) when moist; moderate, medium, granular structure; hard, firm, sticky and plastic; many fine and medium roots; common fine and medium pores; about 25 percent gravel; neutral; clear, smooth boundary.
- AC—22 to 39 inches, grayish-brown (10YR 5/2) gravelly heavy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; hard, firm, sticky and plastic; few fine roots; many fine and medium pores; about 40 percent gravel; neutral; clear, wavy boundary.
- Cca—39 to 60 inches, light-gray (10YR 7/2) gravelly clay loam, dark grayish brown (10YR 4/2) when moist; massive; hard, firm, sticky and plastic; few fine roots; few fine pores; about 20 percent gravel; strongly calcareous; mildly alkaline.

The A1 horizon ranges from dark gray to very dark gray. Texture is gravelly loam to stony loam. Reaction is neutral to mildly alkaline. Thickness ranges from 20 to 25 inches. The content of gravel in the A1 horizon is 15 to 35 percent. The Cca and C horizons range from light gray to very pale brown in hues of 10YR to 2.5Y. Texture is gravelly loam, gravelly clay loam, or very gravelly loam. The very gravelly loam is at a depth of more than 40 inches. The content of coarse fragments ranges from 10 to 35 percent. Reaction is mildly alkaline to neutral. This horizon is moderately to strongly calcareous. The depth to the horizon of carbonate accumulation ranges from 23 to 46 inches.

This soil is fairly easy to till. Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. This soil holds about 7.5 to 9 inches of available water to a depth of 5 feet. Plant roots extend to a depth of 5 feet or more.

Included in mapping were small areas of Hyrum gravelly loam, 10 to 25 percent slopes, and small areas of limestone rock outcrop.

This soil is used mostly for dryfarmed crops of small grain and alfalfa. Some areas are used for range. (Capability unit IVe-UX, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Blackrock gravelly loam, 3 to 6 percent slopes (BmB).—This soil is on alluvial fans. It is associated with Blackrock gravelly loam, 10 to 20 percent slopes, and is similar to that soil, except that the surface layer is 20 to 27 inches thick. Runoff is slow, and the hazard of erosion is slight.

Included in mapping were small areas of loamy, non-gravelly soils and a few small cobbly and stony areas.

This soil is used mostly for dryfarmed crops of winter wheat and alfalfa. (Capability unit IIe-2, irrigated, IIIe-UX, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Blackrock gravelly loam, 6 to 10 percent slopes (BmC).—This soil is on alluvial fans. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas where slopes are 10 to 20 percent.

About 50 percent of the acreage is used for dryfarmed crops of alfalfa and winter wheat, and the rest is used for range. (Capability unit IIIe-2, irrigated, IIIe-UXE, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Blackrock extremely stony loam, 10 to 20 percent slopes (BmD).—This soil is on the high lake terrace escarpments in the vicinity of the town of Cove. It is similar to Blackrock gravelly loam, 10 to 20 percent slopes, except that from 15 to 25 percent of the surface layer and the subsoil is stones and as much as 70 percent of the lower part of the substratum is cobblestones and other stones. Also, the surface layer is 20 to 23 inches thick. The available water holding capacity is 6 to 7 inches. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of soil that has a clay loam texture, and small wet spots or seep areas. Also included were small areas of limestone rock outcrop.

This soil is used for range. It is too stony for cultivation. (Capability unit VIIs-U4, nonirrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Bradshaw Series

The Bradshaw series consists of well-drained soils. These soils formed in colluvium derived from limestone. They are on north- and east-facing mountain areas or in slightly concave drainageways between ridges. The elevation ranges from 6,000 to 7,500 feet. Slopes range from 30 to 60 percent. The vegetation is dominantly Great Basin wildrye, bluebunch wheatgrass, serviceberry, big sagebrush, chokeberry, and snowberry. The average annual precipitation ranges from 20 to 25 inches, the mean

annual air temperature ranges from 38° to 42° F., and the frost-free season is 80 to 100 days. Bradshaw soils are commonly associated with Mult, Agassiz, Elwood, and Dateman soils.

In a representative profile, the surface layer is dark-brown, neutral silt loam about 14 inches thick. The subsoil is yellowish-brown, neutral cobbly loam about 13 inches thick. The substratum is yellowish-brown, neutral very cobbly loam. Limestone bedrock is at depths below 40 inches in places.

Bradshaw soils are used entirely for range, watershed, and wildlife habitat.

Bradshaw-Agassiz association, eroded (30 to 70 percent slopes) (BSG2).—This mapping unit consists of soils mainly in mountainous areas between Davenport Creek and the lower part of Blacksmith Fork Canyon. About 55 percent of the association is Bradshaw silt loam, 30 to 60 percent slopes; 40 percent is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded; and 5 percent is included soils.

The Bradshaw soil is steep and very steep and has slightly concave slopes that face north and east. It is between spur ridges in mountainous areas. The vegetation is mainly snowberry, ceanothus, big sagebrush, serviceberry, chokeberry, and bluebunch wheatgrass.

The Agassiz soil is very steep and has slightly convex slopes that face south and west. The vegetation is mainly big sagebrush, serviceberry, curlleaf mountain-mahogany, and bluebunch wheatgrass.

Representative profile of Bradshaw silt loam having slopes of 30 to 60 percent, in an area of the Bradshaw-Agassiz association, eroded, 200 feet north of the south quarter corner of sec. 8, T. 8 N., R. 2 E.:

- A1—0 to 14 inches, dark-brown (10YR 3/3) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine, medium, and large roots; 10 percent gravel; neutral; gradual, irregular boundary.
- B2—14 to 27 inches, yellowish-brown (10YR 5/4) cobbly loam, dark yellowish brown (10YR 4/4) when moist; weak, very coarse, subangular blocky structure that parts to weak, fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; common fine, medium, and large roots; 40 percent cobblestones and gravel; neutral; clear, wavy boundary.
- C—27 to 60 inches, yellowish-brown (10YR 5/4) very cobbly loam, dark yellowish brown (10YR 4/4) when moist; massive; soft, very friable, nonsticky and nonplastic; few fine and medium roots; 50 percent gravel and cobblestones; neutral.

The A1 horizon ranges from dark brown to brown. This horizon is dominantly silt loam but in places is gravelly very fine sandy loam that is 10 to 20 percent gravel, by volume. Reaction is slightly acid to neutral. Thickness ranges from 10 to 19 inches. The B2 horizon ranges from yellowish brown to light brownish gray. It is cobbly loam ranging to gravelly loam that is 30 to 50 percent cobblestones and gravel. Reaction is neutral to moderately alkaline. Thickness ranges from 13 to 22 inches. The C horizon ranges from yellowish brown to brown or pale brown. This horizon ranges from very cobbly loam or very gravelly loam to very gravelly sandy loam that is 40 to 80 percent gravel and cobblestones. Reaction is neutral to moderately alkaline.

Permeability is moderate to moderately rapid. This soil holds 5 to 7 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 4 feet or more. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Included in mapping were areas of Lucky Star gravelly loam, 30 to 60 percent slopes, and of Bickmore gravelly silt loam, 30 to 70 percent slopes.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Bradshaw soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Cache Series

The Cache series consists of poorly drained, saline soils. These soils formed in fine-textured lake sediment on flat valley bottoms or on lake plains. They are mainly west of Amalga. Elevations are from 4,420 to 4,440 feet. Slopes are 0 to 1 percent. The vegetation is saltgrass and pickleweed. Large areas are bare. The average annual precipitation is 14 to 17 inches, the mean annual air temperature ranges from 45° to 48° F., and the frost-free season is 110 to 160 days. Cache soils are associated with Trenton and Jordan soils.

In a representative profile, the surface layer is light brownish-gray, mildly alkaline silty clay about 4 inches thick. The underlying layer is light-gray and very pale brown to white, mildly alkaline silty clay that extends to a depth of more than 60 inches. These soils are strongly calcareous and strongly affected by salt and alkali.

Cache soils are essentially wasteland, but they have some use for wildlife habitat.

Cache silty clay (Cc).—This soil is on salt-encrusted lake plains, mainly west of Amalga and north of Trenton. Slopes are 0 to 1 percent.

Representative profile, about 1/2 mile north and 2 miles west of Amalga Church, 800 feet east and 200 feet north of the southwest corner of the quarter of sec. 14, T. 13 N., R. 1 W.:

A1sa—0 to 4 inches, light brownish-gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, very fine, subangular blocky structure and weak, fine, granular structure; hard, firm, sticky and plastic; strongly calcareous; mildly alkaline; abrupt, smooth boundary.

C1sa—4 to 25 inches, light-gray (10YR 7/2) silty clay, brown (10YR 5/2) when moist; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; massive; extremely hard, very firm, very sticky and very plastic; strongly calcareous; mildly alkaline; distinct, smooth boundary.

C2sa—25 to 39 inches, very pale brown (10YR 7/3) silty clay, brown (10YR 5/3) when moist; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; massive; extremely hard, very firm, very sticky and very plastic; strongly calcareous; mildly alkaline; abrupt, wavy boundary.

C3sa—39 to 72 inches, white (5Y 8/2 and 10YR 8/2) silty clay, light olive gray (5Y 6/2) and light brownish gray (10YR 6/2) when moist; common, medium, distinct, yellowish-red (5YR 4/8) mottles; massive; extremely hard, very firm, very sticky and very plastic; strongly calcareous; mildly alkaline.

The A1 horizon ranges from light grayish brown to pale olive in a hue of 10YR, 2.5Y, or 5Y. Reaction is mildly to strongly alkaline. Thickness ranges from 3 to 5 inches. Texture is silty clay to heavy silty clay loam. The C horizon

dominantly is white to light gray or very pale brown and ranges in a hue of 10YR, 2.5Y, or 5Y. Texture is silty clay to clay. Common to many, medium and coarse, distinct mottles ranging in color from 7.5YR 4/4 to 5Y 4/8 are below the surface soil. Reaction is mildly alkaline to strongly alkaline.

A salt crust commonly is on the surface, and the content of salt is more than 2 percent throughout the profile. Permeability is very slow. Runoff is very slow to ponded, saturated with water, but little of the water is available for plant growth because of the high content of salt. The water table generally is at or near the surface, and some areas are ponded for long periods.

Included in mapping were small areas of Airport silty clay loam.

In most places this soil is bare and is not suitable for cropping. It has limited use for wildlife habitat. (Capability unit VIIIw-28, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 1)

Cardon Series

The Cardon series consists of somewhat poorly drained soils that formed in mixed lake sediment derived from limestone and shale. These soils are on low lake terraces in the Youngward area southwest of the city of Logan. The elevation ranges from 4,420 to 4,470 feet. Slopes range from 0 to 3 percent. In uncultivated areas, mound micro-relief is evident. The vegetation is foxtail, Kentucky bluegrass, saltgrass, and gumweed. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 46° to 48° F., and the frost-free season is 120 to 130 days. Cardon soils are most commonly associated with Greenson, Salt Lake, Collett, Nibley, and Logan soils.

In a representative profile, the surface layer is dark-gray, mildly alkaline silty clay about 11 inches thick. Below this is 51 inches of light-gray silty clay. The substratum is light-gray, extremely hard, massive silty clay that contains yellowish-brown or brown mottles. In summer, cracks from 1 to 2 inches wide open in the surface layer and in the material below it and remain open for more than 90 days unless the soil is irrigated. Deep cracking, to depths of 40 to 55 inches, and sloughing of soil material from the surface layer into the cracks have caused a mixing of colors below a depth of 10 to 15 inches (fig. 3). The soil generally is saturated within a depth of 30 inches if it is not drained, but it dries out to depths of 40 to 60 inches late in summer.

Cardon soils are used for irrigated crops and unimproved pasture.

Cardon silty clay (Cd).—This soil is on the broad, smooth, low lake terraces. Slopes are 0 to 3 percent.

Representative profile in a cultivated area, 1 1/2 miles north of College Ward Church, 400 feet south and 200 feet east of the northwest corner of the northeast quarter of sec. 18, T. 11 N., R. 1 E.:

Ap—0 to 7 inches, dark-gray (2.5Y 4/1) silty clay, very dark gray (2.5Y 3/1) when moist; moderate, medium, sub-angular blocky structure that parts to weak, fine, granular structure; extremely hard, firm, sticky and plastic; common medium and large roots; few fine pores; moderately calcareous; mildly alkaline; clear, smooth boundary.



Figure 3.—Profile of Cardon silty clay. Deep cracks form when this soil is dry. Dark-colored veins can be seen in the light-colored underlying material, where material from the surface layer has washed into the cracks.

- A12—7 to 11 inches, dark-gray (2.5Y 4/1) silty clay, very dark gray (2.5Y 3/1) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; extremely hard, extremely firm, sticky and plastic; many fine roots and few medium roots; common fine pores; moderately calcareous; mildly alkaline; clear, irregular boundary.
- AC—11 to 34 inches, light-gray (2.5Y 7/2) and dark-gray (2.5Y 4/1) silty clay, light brownish gray (2.5Y 6/2) and very dark gray (2.5Y 3/1) when moist; irregular shaped peds with long axis not parallel to the surface; common slickensides; extremely hard, extremely firm, sticky and plastic; common fine roots and few medium roots; many fine pores; strongly calcareous; mildly alkaline; clear, irregular boundary.
- C1—34 to 62 inches, light-gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) when moist; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; extremely hard, extremely firm, sticky and plastic; few medium roots; common fine pores; strongly calcareous; moderately alkaline.

The A horizon ranges from very dark gray to gray in a hue of 10YR or 2.5Y. Texture ranges from silty clay to heavy silty clay loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is moderately calcareous. Its thickness ranges from 7 to 12 inches. The AC horizon is mixed, consisting of about 50 percent material that is A1 horizon and 50 percent C horizon. The upper part is dominated by the A1 horizon, and the lower part by the C horizon. The paralleliped structure is weak to moderate, and slickensides are common to many. The C horizon ranges from light gray to light grayish brown in a hue of 10YR or 2.5Y. Texture ranges from silty clay to clay or heavy silty clay loam. Reaction ranges from moderately alkaline to strongly alkaline, and the horizon is strongly calcareous. Common, medium, distinct, yellowish-brown mottles occur at depths between 20 and 40 inches.

This soil is sticky and difficult to till. Permeability is very slow. This soil holds from 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate to depths of 5 feet or more. Runoff is slow, and the hazard of erosion is none to slight.

Included in mapping were a few small areas of Salt Lake soils.

This soil is used for irrigated crops and native pasture. The principal crops are alfalfa, small grains, and improved pasture plants. Some sugar beets and corn and silage is grown. (Capability unit IIIw-25, irrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Center Creek Series

The Center Creek series consists of somewhat poorly drained soils that formed in mixed alluvium derived mainly from limestone rocks. These soils are on dry lake bottoms or fans at elevations of 5,600 to 5,700 feet. Slopes range from 1 to 3 percent. The vegetation is mainly water-tolerant grasses and sedges. Average annual air temperature is 42° to 44° F., and the frost-free season 75 to 90 days. Center Creek soils are associated with the soils of the Clegg and Hendricks series.

In a representative profile, the surface layer is dark grayish-brown, medium acid silt loam about 8 inches thick. The subsoil is dark grayish-brown and pale-brown, slightly acid silty clay loam 34 inches thick. The substratum, to a depth of 60 inches or more, is pale-brown, neutral silty clay loam and light yellowish-brown very fine sandy loam.

Center Creek soils are used for dryfarming, hay, and pasture. Alfalfa and small grain are the principal crops.

Center Creek silt loam (CE).—This soil is on valley bottoms in the Dry Lake area. Slopes are 1 to 3 percent.

Representative profile, approximately 800 feet west of the east quarter corner of sec. 32, T. 10 N., R. 1 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; hard, friable, slightly sticky and plastic; common fine roots and few medium and large roots; common, very fine, discontinuous, interstitial pores; medium acid; abrupt, smooth boundary.

B1—8 to 15 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure; very hard, firm, sticky and plastic; common fine roots and few medium and large roots; many, very fine, continuous, horizontal, impeded tubular pores; few thin clay films in pores; slightly acid; gradual, smooth boundary.

- B21t**—15 to 26 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; strong, coarse, prismatic structure; very hard, very firm, sticky and plastic; common fine roots and few medium roots; many, very fine, continuous, vertical, lined tubular pores; common, moderately thick clay films in pores; slightly acid; gradual, wavy boundary.
- B22t**—26 to 34 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; common, coarse, distinct, strong-brown (7.5YR 5/8) mottles; moderate, coarse, prismatic structure; hard, firm, slightly sticky and plastic; many very fine tubular pores and few, fine, continuous tubular pores; common fine roots and few medium roots; few thin clay films in pores; thin organic staining on ped surfaces; slightly acid; gradual, wavy boundary.
- B23t**—34 to 42 inches, pale-brown (10YR 6/3) light silty clay loam, brown to dark brown (10YR 4/3) when moist; common, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, coarse, prismatic structure; hard, firm, slightly sticky and plastic; common very fine roots and few fine and medium roots; few thin clay films in pores; thin organic staining on ped surfaces; slightly acid; gradual, wavy boundary.
- C1**—42 to 52 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; few, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, coarse, prismatic structure; hard, firm, sticky and plastic; few very fine, fine, and medium roots; many very fine and few fine tubular pores; neutral; clear, smooth boundary.
- C2**—52 to 60 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; many, coarse, distinct, strong-brown (7.5YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; neutral.

The A horizon ranges from dark grayish brown to dark gray. Texture ranges from silt loam to light silty clay loam. Reaction is medium acid to neutral. Thickness ranges from 6 to 9 inches. The B1 horizon is only 4 to 8 inches thick and ranges from dark grayish brown to dark gray. The B2t horizon has common, coarse to fine, distinct mottles at depths below 26 inches. Its texture ranges from silty clay loam to fine sandy loam, and stratification is common.

This soil is fairly easy to till. Permeability is moderately slow. Runoff is slow to very slow, and the hazard of erosion is slight. Some areas are inundated until early in summer during years of high runoff. This soil holds 11 to 13 inches of available water to a depth of 5 feet. The depth to the water table ranges from 28 to 40 inches during the growing season. Roots are mostly in the upper 30 inches, above the water table, but extend to a depth of 60 inches or more.

This soil is used mostly for alfalfa, small grain, and native pasture. Water management and controlling the water table are important management needs. (Capability unit IIIw-3, irrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Clegg Series

The Clegg series consists of well-drained soils that formed in alluvium derived chiefly from limestone. These soils are on alluvial fans at elevations of 5,600 to 6,000 feet. Slopes range from 20 to 30 percent. The vegetation is dominantly maple, chokecherry, and some aspen and an understory grasses and forbs. The average annual precipitation is 22 to 24 inches, the mean annual air temperature is 42° to 43° F., and the frost-free season is 80

to 100 days. Clegg soils are most commonly associated with Bickmore, Agassiz, Datwyler, and Sheep Creek soils.

In a representative profile, the surface layer is dark-brown, slightly acid silt loam about 6 inches thick. The subsoil is brown, slightly acid heavy loam about 14 inches thick. The substratum, to a depth of 60 inches or more, is pale-brown, mildly alkaline, strongly calcareous very cobbly very fine sandy loam. All carbonates have essentially been leached from the surface layer and the upper part of the subsoil. A distinct layer of carbonate accumulation is at a depth of about 25 inches.

Clegg soils are used for range, watershed, and wildlife habitat.

Clegg silt loam, 20 to 30 percent slopes (CFE).—This soil is on alluvial fans in the Dry Lake area.

Representative profile, 1,600 feet south and 200 feet east of the northwest corner of sec. 29, T. 10 N., R. 1 W.:

- O1**—1½ inches to 0, matted leaves and twigs.
- A1**—0 to 6 inches, dark-brown (7.5YR 3/2) silt loam, very dark brown (7.5YR 2/2) when moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots and few large roots; common fine interstitial pores and few medium, interstitial pores; 10 percent gravel; slightly acid; gradual, wavy boundary.
- B2t**—6 to 20 inches, brown (7.5YR 4/2) heavy loam, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; many fine and medium roots and few large roots; common fine interstitial pores; few thin clay films in pores and on some ped faces; 10 percent gravel; slightly acid; gradual, wavy boundary.
- IIIC1**—20 to 25 inches, pale-brown (10YR 6/3) very cobbly very fine sandy loam, olive brown (2.5Y 4/3) when moist; weak, medium, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and medium roots; common fine pores; 60 to 70 percent cobblestones and gravel; neutral; clear, smooth boundary.
- IIIC2ca**—25 to 60 inches, pale-brown (10YR 6/3) very cobbly very fine sandy loam, olive brown (2.5Y 4/3) when moist; massive; soft, very friable, nonsticky and nonplastic; few fine and medium roots; 60 to 80 percent cobblestones and gravel; strongly calcareous; mildly alkaline.

The O1 horizon ranges from 1 to 2 inches in thickness. The A1 horizon ranges from dark brown to dark grayish brown in a hue of 10YR or 7.5YR. Texture ranges from silt loam to loam that contains 10 to 15 percent gravel in places. Thickness ranges from 6 to 20 inches. The B2t horizon ranges from brown to dark grayish brown in hues of 7.5YR and 10YR. This horizon ranges from heavy loam to heavy silt loam and is about 10 percent gravel. The C horizon ranges from pale brown to light yellowish brown or to light brownish gray in a hue of 10YR or 2.5Y. It ranges from very cobbly very fine sandy loam to very cobbly fine sandy loam and is about 60 to 80 percent cobblestones and gravel. Depth to a distinct horizon of carbonate accumulation ranges from about 20 to 30 inches.

Permeability is moderate. This soil holds about 6 to 8 inches of available water to a depth of 5 feet. Roots extend to a depth of 5 feet or more. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Hendricks silt loam, 10 to 20 percent slopes, and Elzinga silt loam, 6 to 30 percent slopes.

This Clegg soil is used for range, watershed, and wildlife habitat. (Capability unit VIe-MN, nonirrigated; Mountain Loam (Shrubs) range site; not in a woodland suitability group; wildlife suitability group 3)

Cluff Series

The Cluff series consists of well-drained soils. These soils formed in residuum and colluvium derived from sandstone, shale, and quartzite. They are on mountains at elevations of 7,200 to 8,500 feet. Slopes range from 6 to 30 percent. The vegetation is Douglas-fir, alpine fir, and some aspen. Average annual precipitation is 25 to 35 inches and is mostly snow. The mean annual air temperature ranges for 36° to 42° F., and the mean soil temperature is less than 59°. Cluff soils are associated with Scout, Lucky Star, Agassiz, and Hoskin soils.

In a representative profile, the surface layer is dark-brown or brown, medium acid to slightly acid silt loam about 9 inches thick. The subsurface layer is light-brown, medium acid very gravelly loam about 15 inches thick. Below this is light reddish-brown very gravelly clay loam about 7 inches thick. The subsoil is reddish-yellow, strongly acid very gravelly clay to a depth of 60 inches or more.

Cluff soils are used mainly for watershed and wildlife habitat. Some areas are used for wood products and some range.

Cluff silt loam, 6 to 30 percent slopes (CGE).—This soil is on mountains east of Hardware Ranch in the Baxter Sawmill area.

Representative profile of Cluff silt loam, 6 to 30 percent slopes, 1,200 feet south and 200 feet west of the northeast corner of sec. 9, T. 10 N., R. 4 E.:

O1—2½ to 2 inches, fir needles.

O2—2 inches to 0, partly decomposed litter that is mostly fir needles.

A11—0 to 4 inches, dark-brown to brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine, medium, and large roots; medium acid; clear, wavy boundary.

A12—4 to 9 inches, brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/3) when moist; weak, coarse, subangular blocky structure that parts to fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine, medium, and large roots; common, very fine, discontinuous, random and impeded interstitial pores; thick, continuous, light-colored coatings; slightly acid; clear, wavy boundary.

A22—9 to 24 inches, light-brown (7.5YR 6/3) very gravelly loam, brown (7.5YR 4/3) when moist; weak, coarse, subangular blocky structure that parts to medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common, fine and medium roots and few large roots; common, very fine, discontinuous, random and impeded interstitial pores; 65 percent gravel; medium acid; diffuse, wavy boundary.

A2&B2t—24 to 31 inches, about 60 percent of this horizon is similar to the A22 horizon and the 40 percent B2t part is light reddish-brown (5YR 6/4) very gravelly clay loam, light reddish brown (5YR 6/4) when moist; moderate, coarse, fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots and few large roots; common, very fine, discontinuous, random impeded and interstitial pores; common thin clay films in pores; thick, light-colored coatings on peds; 60 percent gravel; strongly acid; clear, wavy boundary.

B2t—31 to 62 inches; reddish-yellow (5YR 6/6) very gravelly light clay, yellowish red (5YR 4/6) when moist; moderate, coarse to fine, subangular blocky structure; very hard, very firm, sticky and very plastic; few fine, medium, and large roots; common, very fine, discontinuous, random impeded, interstitial, and tubular

pores; common moderately thick clay films; moderate, patchy, light-colored coatings; 50 percent gravel; strongly acid.

The thickness of the O horizon ranges from 2 to 4 inches. The combined thickness of the A1, A2, and B2t horizons ranges from 40 to 60 inches. Coarse fragments are mainly cobbles and gravel-size angular rock fragments; their content ranges from 5 to 50 percent in the A1 horizon, from 20 to 60 percent in the A2 horizon, and from 50 to 90 percent in the B2t horizon. The A1 horizon has a hue of 10YR or 7.5YR. Texture is very fine sandy loam. Thickness ranges from 6 to 9 inches. The A2 horizon ranges from light brown to reddish yellow or pale brown in a hue of 10YR or 7.5YR. Texture ranges from very gravelly loam to gravelly very fine sandy loam. Reaction ranges from slightly acid to strongly acid. Thickness ranges from 6 to 18 inches. The B2t horizon ranges from reddish yellow to reddish brown or strong brown in hues of 7.5YR, 5YR, and 2.5YR. Texture ranges from very cobbly clay or very gravelly clay to very gravelly heavy clay loam. Reaction ranges from medium acid to strongly acid.

Permeability is moderate. This soil holds 5 to 7 inches of available water to a depth of 5 feet. Roots extend to a depth of 5 feet or more. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in mapping were small areas of Lucky Star silt loam, 6 to 30 percent slopes, which is under aspen.

This Cluff soil is used mainly as woodland and for watershed and wildlife habitat. Some areas are grazed by sheep. (Capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4)

Cluff-Lucky Star association (6 to 30 percent slopes) (CHE).—This mapping unit consists of soils mainly at the head of Hyrum Dry Canyon. About 60 percent of the association is Cluff silt loam, 6 to 30 percent slopes; 25 percent is Lucky Star silt loam, 6 to 30 percent slopes; and about 15 percent is included soils.

The Cluff and Lucky Star soils are on all exposures on mountains. The slopes are dominantly 10 to 20 percent. The landscape is rough and broken. The rock formations are tilted, and there are long, narrow, limestone and sandstone ridges that are oriented in a generally north-south direction. The dominant vegetation is conifers and some aspen. The Cluff soil is mainly under conifers, and the Lucky Star soil is mainly under aspen.

Included in mapping were areas of Agassiz rocky silt loam, 6 to 30 percent slopes, and Obay silty clay, 6 to 20 percent slopes. The Agassiz soil makes up about 10 percent of the total acreage in the association, and the Obay soil about 5 percent.

Soils of this mapping unit are used as woodland, for watershed, for wildlife habitat, and for range. (Cluff soil is in capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4. Lucky Star soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4)

Cluff-Scout association (6 to 40 percent slopes) (CIE).—This mapping unit consists of soils east of Hardware Ranch in the vicinity of Baxters Mill. About 70 percent of the association is Cluff silt loam, 6 to 30 percent slopes; 20 percent is Scout gravelly loam, 10 to 40 percent slopes; and 10 percent is included soils.

The Cluff soil is on all exposures on broad mountains. The Scout soil is commonly on ridges and very steep

sides of ridges. A representative profile for the Scout soil is described under the Scout series. Generally, both soils are under Douglas-fir and alpine fir.

Included in mapping were areas of Scare silt loam, 10 to 30 percent slopes, and of Lucky Star silt loam, 6 to 30 percent slopes. Also included were a few outcrops of limestone bedrock at the bottom of mountain sides near the edges of deep canyons.

Soils of this mapping unit are used mainly for watershed, for wildlife habitat, and as woodland, but some areas are grazed by sheep. The wood products are used extensively. (Capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4)

Collett Series

The Collett series consists of somewhat poorly drained soils that formed in mixed, calcareous, lake sediment derived principally from limestone, sandstone, and shale. These soils are on medium and low lake terraces at elevations of 4,450 to 4,700 feet. Slopes range from 0 to 3 percent. The vegetation is foxtail, Kentucky bluegrass, saltgrass, and some sedges and wiregrass. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 45° and 48° F. and the frost-free season is 120 to 140 days. Collett soils are most commonly associated with Greenon, Nibley, Logan, Salt Lake, and Cardon soils.

In a representative profile, the surface layer is gray, mildly alkaline silty clay loam about 12 inches thick. The subsoil is gray to light-gray, moderately alkaline heavy silty clay loam about 5 inches thick. The substratum, to a depth of 60 inches or more, is white, moderately alkaline, strongly calcareous heavy silty clay loam that contains a horizon of carbonate accumulation.

Collett soils are used for irrigated crops and for unimproved meadow and pasture.

Collett silty clay loam (0 to 3 percent slopes) (Ck).—This soil is on the broad, smooth or slightly undulating, low lake terraces throughout Cache Valley.

Representative profile, in a cultivated area 1½ miles south of the Logan-Cache Airport, 1,000 feet south and 1,000 feet east of the northwest corner of the southwest quarter of sec. 21, T. 12 N., R. 1 E.:

Ap—0 to 7 inches, gray (10YR 5/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, granular structure; slightly hard, friable, sticky and plastic; few fine roots; few fine pores; moderately calcareous; mildly alkaline; clear, smooth boundary.

A1—7 to 12 inches, gray (10YR 5/1) heavy silty clay loam, very dark gray (10YR 3/1) when moist; very weak, medium, prismatic structure that parts to moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; common fine roots; slightly calcareous; mildly alkaline; clear, smooth boundary.

B2—12 to 17 inches, gray to light-gray (10YR 6/1) heavy silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium and coarse, prismatic structure that parts to moderate, fine, subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; few fine pores; moderately calcareous; moderately alkaline; clear, smooth boundary.

C1ca—17 to 24 inches, white (2.5Y 8/2) heavy silty clay loam, light brownish gray (10YR 6/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; hard, firm,

sticky and plastic; few fine roots; few medium and fine pores; strongly calcareous; moderately alkaline; clear, smooth boundary.

C2ca—24 to 34 inches, white (2.5Y 8/2) heavy silty clay loam, pale brown (10YR 6/3) when moist; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few fine roots; few fine pores; very strongly calcareous; moderately alkaline; abrupt, smooth boundary.

C3—34 to 60 inches, white (10YR 8/2) heavy silty clay loam, pale brown (10YR 6/3) when moist; common, medium, distinct, olive (5Y 5/6) or yellowish-brown (10YR 5/8) mottles; moderate, thin, platy structure; laminated lake sediment; hard, friable, slightly sticky and plastic; few fine roots; strongly calcareous; moderately alkaline.

The A horizon ranges from gray to dark gray. Texture ranges from heavy silty clay loam to heavy silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is slightly to moderately calcareous. Thickness ranges from 7 to 12 inches. The B2 horizon has a hue of 10YR or 2.5Y. Texture ranges from heavy silty clay loam to light silty clay. Reaction is mildly alkaline to moderately alkaline, and the horizon is slightly calcareous to moderately calcareous. Calcium carbonate equivalent in the Cca horizon is 22 to 60 percent. The C horizon ranges from white to pale brown or light gray. Texture ranges from silt loam to silty clay. Few to common, medium, distinct, yellowish-brown to strong-brown mottles are at a depth of more than 24 inches. A horizon of lime accumulation is in the upper part of the substratum at a depth of 16 to 22 inches. In places it is weakly cemented.

This soil is slightly difficult to till. Permeability is slow. This soil holds from 10 to 12 inches of available water to a 5-foot depth. In undrained areas the water table is at a depth of 20 to 36 inches, but in drained areas it is at a depth of 40 to 60 inches. Roots are mainly above the water table, but in drained areas they extend to a depth of 48 inches or more. Runoff is slow, and the hazard of erosion is none to slight.

Included in mapping were small areas of Greenon loam, 0 to 3 percent slopes. Also included were small areas of soils slightly affected by salt and alkali and areas of poorly drained soils.

Much of this Collette soil is drained; both tile and open drain systems are used. Irrigated crops are alfalfa, small grain, sugar beets, pasture, and corn for silage. Areas that have not been drained are used for wet meadow and pasture. (Capability unit IIIw-25, irrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Collinston Series

The Collinston series consists of well-drained soils that formed in mixed sediment derived from light-colored tuff, tuffaceous sandstone, and limestone of the Salt Lake Formation. These soils are strongly undulating or rolling and are on high lake terraces and terrace escarpments at elevations of 4,600 to 5,300 feet. Slopes range from 1 to 30 percent. The vegetation is dominantly bluebunch wheatgrass, cheatgrass, prairie junegrass, slender wheatgrass, Great Basin wildrye, Sandberg bluegrass, balsamroot, and aster. The average annual precipitation is 15 to 17 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 110 to 160 days. Collinston soils are most commonly associated with Mendon, Wheelon, Crookston, Avon, and Blackrock soils.

In a representative profile, the surface layer is gray, mildly alkaline loam about 15 inches thick. The underlying layer, to a depth of 60 inches or more, is white to very pale-brown, mildly alkaline to moderately alkaline, strongly calcareous silt loam or clay loam.

Collinston soils are used for dryfarming or for range.

Collinston loam, 6 to 10 percent slopes (CmD).—This undulating soil is on lake terraces. It is most commonly along the west side of Cache Valley in close association with Wheelon and Mendon soils, but some areas are south of Hyrum and east of Richmond.

Representative profile, in a cultivated area 1 mile west of Petersboro railroad warehouse, about 1,100 feet south and 900 feet west of the north quarter corner of sec. 19, T. 12 N., R. 1 W.:

- A11—0 to 8 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; soft, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine pores; moderately calcareous; mildly alkaline; abrupt, smooth boundary.
- A12—8 to 15 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many medium and fine pores; moderately calcareous; mildly alkaline; abrupt, smooth boundary.
- C1ca—15 to 25 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; weak, fine, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; many fine roots; many fine pores and few medium pores; very strongly calcareous; mildly alkaline; diffuse, smooth boundary.
- C2—25 to 35 inches, white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) when moist; massive; hard, friable, slightly sticky and slightly plastic; common fine pores; strongly calcareous; moderately alkaline; abrupt, irregular boundary.
- C3—35 to 60 inches, white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) when moist; few, medium, distinct, yellowish-red (5Y 4/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine pores; strongly calcareous; moderately alkaline.

The A1 horizon ranges from gray to dark gray in hues of 10YR and 2.5Y. Texture ranges from loam to silt loam or light silty clay loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is moderately calcareous to strongly calcareous. Thickness ranges from 7 to 15 inches. The C horizon ranges from white to light gray or light brownish gray. Texture ranges from clay loam to silty clay loam or silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is strongly calcareous to very strongly calcareous. Some lime has been leached from the A horizon and redeposited in the upper part of the C horizon. In some places, partially weathered shale and cobbles are in the C horizon at depths below 40 inches. In some places there are distinct, yellowish-brown or yellowish-red mottles below a depth of 30 inches.

This soil is fairly easy to till. Permeability is moderate. This soil holds 8 to 10 inches of available water to a depth of 5 feet. Roots penetrate easily to depths of about 48 inches. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Wheelon silt loam, 10 to 30 percent slopes, eroded, and small areas of a soil that has a gravelly loam or cobbly loam surface layer.

This soil is used for dryland crops of small grain, alfalfa, and alfalfa-grass mixtures. (Capability unit IVe-

U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Collinston loam, 1 to 6 percent slopes (CmC).—This soil is on medium lake terraces, mainly in the Clarkston-Petersboro area. It is similar to Collinston loam, 6 to 10 percent slopes, except that it has slopes of 1 to 6 percent and the surface layer is 8 to 18 inches thick. Runoff is slow to medium, and the hazard of erosion is slight.

Included with this soil in mapping were small areas of Mendon silt loam, 3 to 6 percent slopes, and small areas of a Collinston silt loam that has slopes of 6 to 10 percent.

This soil is used mostly for dryland crops of winter wheat, alfalfa, and alfalfa-grass mixtures. (Capability unit IIIe-U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Collinston loam, 10 to 30 percent slopes, eroded (CmE2).—This soil is on high lake terraces, mainly in the Clarkston-Petersboro area. It is closely associated with Collinston loam, 6 to 10 percent slopes, and is similar to that soil except that it is steeper and the surface layer is 7 to 8 inches thick. In places, partly weathered shale and cobbles are at a depth below 40 inches. Runoff is rapid, and the hazard of further erosion is high. This soil is moderately eroded.

Included in mapping were areas of Wheelon silt loam, 10 to 30 percent slopes, eroded; small areas of Mendon silt loam, 6 to 10 percent slopes, eroded; and small areas of Mendon silt loam, 6 to 10 percent slopes.

About 60 percent of the acreage is used for dryland crops of winter wheat, alfalfa, and alfalfa-grass mixtures. The remaining 40 percent is used for range that is grazed after crops in adjacent areas have been harvested. (Capability unit VIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Collinston loamy fine sand, 0 to 3 percent slopes (CIA).—This soil is on medium lake terraces north of the Newton cemetery. Slopes are slightly undulating.

The texture of the profile ranges from loamy fine sand to fine sandy loam in places. The surface layer ranges from 6 to 20 inches in thickness.

Included in mapping were small areas of a soil that has slopes of slightly more than 3 percent, and a few small areas of Crookston loam, 0 to 3 percent slopes.

This Collinston soil is easy to work and can be cultivated within a wide range of moisture content. It is somewhat excessively drained and is rapidly permeable. Runoff is very slow. The hazard of erosion is only moderate, but soil blowing is a major hazard. This soil holds 5 to 6 inches of available water to a depth of 5 feet. Sand ridges along fence rows are common.

Most of the acreage is used for dryland crops of alfalfa and winter wheat. A small acreage is sprinkler irrigated; sugar beets, alfalfa, and some corn for silage are grown. (Capability unit IIIs-24, irrigated, IIIs-U4, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crookston Series

The Crookston series consists of well-drained soils that formed in mixed lake sediment derived dominantly from light-colored tuff, tuffaceous sandstone, and limestone of

the Salt Lake Formation. These soils are on medium and high lake terraces at elevations of 4,500 to 5,100 feet. Slopes range from 0 to 10 percent. The vegetation is dominantly big sagebrush, bluebunch wheatgrass, western wheatgrass, and balsamroot. The average annual precipitation is 15 to 17 inches. The mean annual air temperature is 45° to 48° F., and the frost-free season is 120 to 150 days. Crookston soils are most commonly associated with Mendon, Avon, Collinston, and Wheelon soils.

In a representative profile, the surface layer is gray, mildly alkaline loam about 14 inches thick. The subsoil is grayish-brown, mildly alkaline loam about 13 inches thick. The substratum, to a depth of 60 inches, is light-gray, strongly calcareous, mildly alkaline loam and fine sandy loam. Most carbonates have been leached from the surface layer and upper part of the subsoil and redeposited at depths of 20 to 28 inches to form a distinct lime horizon.

Crookston soils are used mainly for dryland crops of alfalfa and small grain. Where water is available, some areas are irrigated.

Crookston loam, 0 to 3 percent slopes (CoA).—This soil is on the medium lake terraces. It is generally on the west side of Cache Valley between the towns of Mendon and Clarkston.

Representative profile, in a cultivated field about 2 miles north and ½ mile west of Newton, 500 feet north and 40 feet east of the southwest corner of sec. 6, T. 13 N., R. 1 W.:

- Ap—0 to 6 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure and weak, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; noncalcareous, mildly alkaline; abrupt, smooth boundary.
- A1—6 to 14 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; common fine pores; noncalcareous; mildly alkaline; clear, smooth boundary.
- B2t—14 to 27 inches, grayish-brown (10YR 5/2) loam, very dark gray (10YR 3/1) when moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and medium pores; common thin clay films; noncalcareous; mildly alkaline; clear, wavy boundary.
- C1ca—27 to 48 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine and medium pores; strongly calcareous; mildly alkaline; clear, smooth boundary.
- C2ca—48 to 60 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; many fine and medium pores; strongly calcareous; mildly alkaline.

The A horizon ranges from gray to dark gray. Its texture is loam, silt loam, or fine sandy loam. The horizon is as much as 5 percent gravel in places. Thickness ranges from 10 to 18 inches. The B2t horizon ranges from grayish brown to gray or dark gray. Texture ranges from loam to silt loam. The C and Cca horizons range from light gray to white or pale yellow in hues ranging from 10YR to 5Y. Texture ranges from clay loam to fine sandy loam. The Cca horizon has a calcium carbonate equivalent of 25 to 35 percent.

This soil is easy to till. Permeability is moderate. Runoff is slow, and the hazard of erosion is slight. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 4 to 6 feet.

Included in mapping were small areas of Mendon silt loam, 0 to 3 percent slopes.

All the acreage of this Crookston soil is cultivated. About 75 percent of the acreage is used for dryland crops of alfalfa, winter wheat, and safflower. The remaining 25 percent is used for irrigated crops of alfalfa, small grain, pasture, sugar beets, and corn for silage. (Capability unit IIc-2, irrigated, IIIe-U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crookston loam, 3 to 6 percent slopes (CoB).—This slightly undulating soil is on lake terraces along the west side of Cache Valley, between the towns of Mendon and Clarkston. It is similar to Crookston loam, 0 to 3 percent slopes, except that it has slopes of 3 to 6 percent, its surface layer is only 7 to 12 inches thick, and its subsoil is only 6 to 12 inches thick. Runoff is slow to medium, and the hazard of erosion is slight.

Included in mapping were a few small areas of soil that has slopes of 6 to 10 percent, and small areas of Collinston loam, 1 to 6 percent slopes.

All the acreage of this Crookston soil is cultivated. About 75 percent of the acreage is used for dryland crops of alfalfa and winter wheat. The remaining 25 percent is used for irrigated crops of alfalfa and small grain. (Capability unit IIe-2, irrigated, IIIe-U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crookston loam, 6 to 10 percent slopes (CoC).—This soil is on high lake terraces. It is similar to Crookston loam, 0 to 3 percent slopes, except that it is steeper, its surface layer is only 7 to 10 inches thick, and its subsoil is only 4 to 12 inches thick. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were a few small areas of a soil that has slopes of 3 to 6 percent, and small areas of Collinston loam, 6 to 10 percent slopes.

This Crookston soil is used mostly for dryland crops of alfalfa and winter wheat, but a few small areas are irrigated. (Capability unit IIIe-2, irrigated, IIIe-UE, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crowshaw Series

The Crowshaw series consists of well-drained soils that formed in alluvium derived mainly from sandstone. These soils are on old alluvial fans deposited on high lake terraces at elevations of 4,500 to 5,000 feet. Slopes range from 3 to 20 percent. The vegetation is blue bunch wheatgrass, western wheatgrass, big sagebrush, and balsamroot. The average annual precipitation is 15 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Crowshaw soils are most commonly associated with Hendricks, Dagor, and Timpanogos soils.

In a representative profile, the surface layer is very dark grayish brown, slightly acid gravelly loam about 16 inches thick. The subsoil is dark-brown to brown, slightly acid gravelly loam about 14 inches thick. The substratum is brown, slightly acid gravelly loam to a depth of 60 inches or more.

Crowshaw soils are used for dry cropland.

Crowshaw gravelly loam, 6 to 10 percent slopes (CrC).—This soil is on old alluvial fans extending from the town of Mendon south almost to Sardine Canyon.

Representative profile, 1½ miles south of Mendon, 1,400 feet south of the northwest corner of the northeast quarter of sec. 20, T. 11 N., R. 1 W.:

- Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) when moist; weak, medium and fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine and medium pores; 15 percent gravel; slightly acid; clear, wavy boundary.
- A1—10 to 16 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine and medium pores; 15 percent gravel; slightly acid; clear, wavy boundary.
- B2—16 to 30 inches, dark-brown to brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; common thin clay films in pores and on some peds; 15 percent gravel; slightly acid; clear, wavy boundary.
- C—30 to 60 inches, brown (7.5YR 5/4) gravelly loam, dark brown to brown (7.5YR 4/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; 20 percent gravel; slightly acid.

The A horizon ranges from very dark grayish brown to dark grayish brown and is 10 to 20 percent gravel. Reaction is slightly acid to neutral. Thickness ranges from 8 to 16 inches. The B horizon ranges from dark brown to brown or to grayish brown in a hue of 7.5YR or 10YR. The horizon is gravelly loam to gravelly heavy loam and is 15 to 25 percent gravel. The C horizon ranges from brown to yellowish brown or to pale brown in a hue of 7.5YR or 10YR. It is gravelly loam or very gravelly loam that is 15 to 35 percent gravel. A few angular cobbles of sandstone and other stones commonly are below a depth of 30 inches. In places there is strongly calcareous lake sediment below a depth of 40 inches.

This soil is fairly easy to till, but the gravel causes excessive wear on tillage implements. Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. This soil holds 7 to 9 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Included in mapping were small areas of Hendricks silt loam, 6 to 10 percent slopes.

This Crowshaw soil is used mostly for dryland crops of alfalfa and small grain. Controlling erosion is the most important concern in management. (Capability unit IIIe-2, irrigated, IIIe-UXE, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crowshaw gravelly loam, 3 to 6 percent slopes (CrB).—This soil is on the lower parts of old alluvial fans along the foothills of the Wellsville Mountains. It is similar to Crowshaw gravelly loam, 6 to 10 percent slopes, except that it has slopes of 3 to 6 percent and the surface layer is 12 to 19 inches thick. Runoff is slow to medium, and the hazard of erosion is slight.

Included in mapping were small areas of soil that is not gravelly, and a few small areas of Hendricks silt loam, 3 to 6 percent slopes. Also included were a few small areas of soil that has slopes of slightly less than 3 percent.

This Crowshaw soil is used for dryland crops of alfalfa and winter wheat. (Capability unit IIe-2, irrigated,

IIIe-UX, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Crowshaw gravelly loam, 10 to 20 percent slopes (CrD).—This soil is on alluvial fans and is associated with Hendricks silt loams and other Crowshaw soils. It is similar to Crowshaw gravelly loam, 6 to 10 percent slopes, except that the surface layer is only 7 to 14 inches thick. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of soils that have an accumulation of cobblestones or stones on the surface. Also included are a few small areas where slopes are slightly more than 20 percent.

This soil is used mostly for dryland crops of alfalfa and winter wheat. A few small areas are used as range. (Capability unit IVe-UX, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Curtis Creek Series

The Curtis Creek series consists of well-drained soils that formed in residuum derived from sandstone. These soils are 13 to 20 inches deep over fractured bedrock. They are on mountains at elevations of 6,000 to 8,000 feet. Slopes range from 10 to 60 percent. The vegetation is dominantly bluebunch wheatgrass, Columbia needlegrass, slender wheatgrass, Great Basin wildrye, native bluegrass, big sagebrush, and yellowbrush. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 38° to 42° F., and the frost-free season is 80 to 100 days. Curtis Creek soils are most commonly associated with Hoskin, Goring, Lucky Star, and Ant Flat soils.

In a representative profile, the surface layer is brown to dark-brown, medium acid loam about 8 inches thick. The subsoil is reddish-brown to yellowish-red slightly acid to neutral heavy loam or light sandy clay loam about 10 inches thick over fractured sandstone bedrock.

Curtis Creek soils are used for range, watershed, and wildlife habitat.

Curtis Creek-Goring association, hilly (6 to 30 percent slopes) (CSE).—This mapping unit consists of soils on mountains that have spur ridges in the Curtis Creek-Mollens Hollow area east of Hardware Ranch. The general aspect is dominantly south, but some exposures face east and west. About 65 percent of the association is Curtis Creek loam, 10 to 30 percent slopes; 25 percent is Goring silt loam, 6 to 10 percent slopes; and about 10 percent is included soils.

The Curtis Creek soil is dominantly moderately steep and is on ridges. The Goring soil is moderately steep in concave areas and swales. The vegetation on both soils is shrubs and grass.

Representative profile of Curtis Creek loam, 6 to 30 percent slopes, in an area of Curtis Creek-Goring association, hilly, 1,300 feet north and 1,200 feet west of southeast corner of sec. 19, T. 10 N., R. 4 E.:

- A1—0 to 8 inches, brown to dark-brown (7.5YR 4/3) loam, very dark brown (7.5YR 2/2) when moist; moderate, fine, granular structure; slightly hard, friable, non-sticky and slightly plastic; many fine and very fine roots and a few medium roots; medium acid; clear, smooth boundary.

B21t—8 to 12 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky and angular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium roots; few, fine, discontinuous, random, inped pores; common thin clay films on peds and in pores; 10 percent gravel; slightly acid; clear, wavy boundary.

B22t—12 to 18 inches, yellowish-red (5YR 5/6) light sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine and medium roots; common, fine, discontinuous, random pores; common thin clay films on ped surfaces and in pores; neutral; abrupt, smooth boundary.

R—18 inches, light-red (2.5YR 6/6) fractured and weathering calcareous sandstone, red (2.5YR 4/6) when moist.

The A1 horizon ranges from brown to dark brown or reddish brown in hues of 10YR to 5YR. Texture is dominantly loam but ranges to cobbly loam. In places the A horizon is as much as 20 percent cobbles and gravel. Reaction is medium acid to neutral. Thickness ranges from 8 to 11 inches. The B2t horizon ranges from reddish brown or yellowish red to red in hues of 5YR and 2.5YR. It ranges from loam to light clay loam and in places is as much as 20 percent gravel.

Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. These soils hold 3.5 to 4 inches of available water above the bedrock. Some roots extend into cracks in the bedrock, but most roots are within a depth of 20 inches.

Included in mapping were areas of Hoskin cobbly loam, 10 to 30 percent slopes; Agassiz rocky silt loam, 6 to 30 percent slopes; and Lucky Star silt loam, 6 to 20 percent slopes. The Hoskin and Agassiz soils are on spur ridges. The Lucky Star soil has slopes that face east, and the vegetation on it is aspen.

Soils in this mapping unit are used for range, watershed, and wildlife habitat. (Curtis Creek soil is in capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3. Goring soil is in capability unit VIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Curtis Creek-Goring association, steep (30 to 60 percent slopes) (CSG).—This mapping unit consists of soils in the vicinity of Rock Creek, northeast of Hardware Ranch. About 50 percent of the association is Curtis Creek loam, 30 to 60 percent slopes; 25 percent is Goring silt loam, 30 to 60 percent slopes; 20 percent is Lucky Star gravelly silt loam, 30 to 60 percent slopes; and about 5 percent is included soils. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

The Curtis Creek soil is in very steep mountain areas that face south, east, and west. The surface layer is 8 to 10 inches thick. The vegetation is sagebrush and grass.

The topography of the Goring soil is generally the same as the Curtis Creek soil, except that the soil is in concave areas.

The Lucky Star is on north-facing slopes of mountains. The vegetation is aspen.

Included in mapping were areas of Curtis Creek loam, 10 to 30 percent slopes, and areas of rock outcrop.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Curtis Creek soil is in capability unit VIIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3. Goring soil is in capability

unit VIIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3. Lucky Star soil is in capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; not in a woodland suitability group; wildlife suitability group 3)

Dagor Series

The Dagor series consists of well-drained soils that formed in recent alluvium that was derived from sandstone rocks and was washed from the eroded surface layer of the adjacent upland soils. Dagor soils are mainly on alluvial fans along the foothills on the east side of Wellsville Mountain. The elevation ranges from 4,900 to 5,150 feet. Slopes range from 4 to 20 percent. The vegetation is sagebrush, scrubby maple, and wheatgrasses. The average annual precipitation is 17 to 18 inches, the mean annual air temperature is 46° to 47° F., and the frost-free season is 120 to 140 days. Dagor soils are most commonly associated with Crowshaw and Hendricks soils.

In a representative profile, the soil is dark grayish-brown to brown, slightly acid to neutral silt loam that extends to a depth of 60 inches or more.

Dagor soils are used for dryland crops of alfalfa and small grain.

Dagor silt loam, 10 to 20 percent slopes (DcD).—This soil is on the upper part of alluvial fans, mostly south of the town of Wellsville.

Representative profile, 1,400 feet south and 500 feet west of the northeast corner of the northwest quarter of sec. 27, T. 10 N., R. 1 W.:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft, friable, nonsticky and slightly plastic; common medium and fine roots; few medium pores; neutral; clear, smooth boundary.

A11—5 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft, friable, nonsticky and plastic; many fine roots; common fine and medium pores; slightly acid; gradual, wavy boundary.

A12—14 to 34 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure; soft, friable, nonsticky and slightly plastic; many fine roots; few large pores and common medium pores; neutral; gradual, wavy boundary.

AC—34 to 46 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark brown (10YR 2/2) when moist; weak, fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine roots; common medium pores and many fine pores; slightly acid; clear, wavy boundary.

C—46 to 60 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and plastic; common fine roots; common medium pores and many fine pores; neutral.

The A horizon ranges from dark grayish brown to brown. Its texture is silt loam to loam. Thickness ranges from 20 to 36 inches. The C horizon ranges from brown to yellowish brown in hues of 7.5YR and 10YR. It is silt loam to loam and in places is as much as 40 percent gravel. Reaction is slightly acid to neutral.

This soil is easy to till. Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Included in mapping were small areas of a soil that has slopes of 5 to 10 percent and a few small areas of a soil that has slopes of slightly more than 20 percent.

This Dager soil is used almost entirely for dryland crops of alfalfa and winter wheat. (Capability unit IVE-2, irrigated, IVE-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Dager silt loam, 4 to 8 percent slopes (DcC).—This soil is on the lower part of alluvial fans along the foothills of the Wellsville Mountains. In places the substratum, below a depth of 36 inches, is as much as 40 percent sandstone gravel. The pebbles are mostly less than 1 inch in diameter. In places small amounts of gravel are scattered throughout the profile. Runoff is slow to medium, and the hazard of erosion is slight.

Included in mapping were small areas of Hendricks silt loam, 3 to 6 percent slopes, and Crowshaw gravelly loam, 3 to 6 percent slopes. Also included were small areas of gravelly and cobbly soils that are on the upper part of fans.

This Dager soil is used almost entirely for dryland crops of alfalfa and winter wheat. (Capability unit IIIe-2, irrigated, IIIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Dateman Series

The Dateman series consists of well-drained soils that formed in residuum and colluvium derived from limestone. These soils are underlain by bedrock at a depth of 26 to 40 inches. They are steep to very steep and are on north- and east-facing slopes at elevations of 6,200 to 9,000 feet. Slopes range from 40 to 70 percent. The vegetation is Douglas-fir and alpine fir. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is 35° to 40° F., and the mean soil temperature in summer is less than 60°. The frost-free season is 70 to 90 days. Dateman soils are most commonly associated with Agassiz, Bradshaw, Smarts, Elwood, and Lucky Star soils.

In a representative profile, the surface layer is dark-brown to brown, neutral cobbly silt loam about 24 inches thick. The subsoil is brown to dark-brown, mildly alkaline very cobbly silty clay loam about 10 inches thick. Limestone bedrock is at a depth of about 34 inches.

Representative profile of Dateman cobbly silt loam in an area of Agassiz-Dateman association, eroded, in Paradise Dry Canyon, 1,700 feet east of the west quarter corner of sec. 5, T. 9 N., R. 2 E.:

O1—2 inches to 0, decomposing needles and twigs.

A11—0 to 14 inches, dark-brown to brown (10YR 4/3) cobbly silt loam, very dark brown (7.5YR 2/2) when moist; weak, fine, granular structure; soft, very friable, non-sticky and slightly plastic; many fine roots, common medium roots, and few large roots; 20 percent cobblestones; neutral; gradual, wavy boundary.

A12—14 to 24 inches, brown (10YR 5/3) cobbly heavy silt loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots and few medium and large roots; 40 to 50 percent cobblestones; neutral; gradual, irregular boundary.

B2—24 to 34 inches, brown to dark-brown (7.5YR 4/4) very cobbly light silty clay loam, dark brown (7.5YR 3/4) when moist; weak, medium and coarse, subangular blocky structure; hard, friable, slightly sticky and plastic; few fine, medium, and large roots; many very fine, discontinuous, interstitial pores; few thin clay films in pores and on ped surfaces; 70 percent cobblestones; noncalcareous; mildly alkaline; abrupt, irregular boundary.

R—34 inches, fractured weathering limestone bedrock that has some B2 material in the larger cracks and accumulations of calcium carbonate on the undersides of rock fragments.

The combined thickness of the A1 and B2t horizons over the fractured limestone bedrock ranges from 26 to 40 inches. The content of cobblestones and gravel generally increases with increasing depth.

Permeability is moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. These soils hold 4 to 5 inches of available water above the bedrock. Roots are mostly within a depth of 27 to 40 inches, but some extend into cracks in the bedrock.

Dateman-Bradshaw association (30 to 70 percent slopes) (DHG).—This mapping unit consists of soils in the vicinity of Davenport Creek on mountains that have many spur ridges. About 60 percent of the association is Dateman cobbly silt loam, 40 to 70 percent slopes; 30 percent is Bradshaw silt loam, 30 to 60 percent slopes; and about 10 percent is included soils.

The Dateman soil is steep and very steep, and it has north- and east-facing slopes. The Bradshaw soil is in slightly concave areas between spur ridges.

Included in mapping were areas of Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and Mult silt loam, 30 to 50 percent slopes. The Agassiz soil is on convex ridges, where the vegetation is curlleaf mountain-mahogany and various browse plants. The Mult soil is in concave areas, where the vegetation is aspen.

Soils of this mapping unit are used for range, wildlife habitat, woodland, and watershed. (Dateman soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4. Bradshaw soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Dateman extremely rocky silt loam, 40 to 80 percent slopes (DEG).—This very steep mapping unit is on north-facing canyon walls that dissect mountains, mostly in the Blacksmith Fork Canyon and on the Wellsville Mountains. It is about 40 to 60 percent Dateman cobbly silt loam, 40 to 70 percent slopes; 30 percent Rock land and rock outcrop; and 10 percent included soils.

The Dateman soil is in slightly concave areas between areas of Rock land and rock outcrop. This soil is similar to Dateman cobbly silt loam, 40 to 70 percent slopes, described under the series. Slopes are dominantly 60 to 70 percent. The vegetation is Douglas-fir and alpine fir and a sparse understory of chokecherry, snowberry, Oregon grape, and mountain-myrtle.

Rock land and rock outcrop are dominantly limestone. Rock land has slopes of 60 to 80 percent or more. Some of the rock outcrop is in perpendicular cliffs, and rock ledges are common.

Included in mapping were areas of Agassiz soils.

This soil is used for watershed and wildlife habitat. The wooded areas have not been used extensively, because the landscape is rough and harvesting is difficult. (Capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4x1; wildlife suitability group 4)

Datwyler Series

The Datwyler series consists of well-drained soils that formed in residuum and colluvium derived from limestone and calcareous sandstone rocks. These soils are on south- and west-facing mountain areas at elevations of 5,000 to 7,000 feet. Slopes range from 30 to 60 percent. The vegetation is bluebunch wheatgrass, native bluegrass, slender wheatgrass, lupine, big sagebrush, and serviceberry. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 40° to 45° F., and the frost-free season is 90 to 110 days. Datwyler soils are associated with Maughan, Elzinga, Sheep Creek, and Agassiz soils.

In a representative profile, the surface layer is brown, neutral cobbly silty clay loam about 4 inches thick. The subsoil is brown and reddish brown, neutral very cobbly clay about 24 inches thick. The substratum is pink, strongly calcareous, mildly alkaline very cobbly sandy clay loam. Bedrock is at a depth of about 35 inches. Carbonates have been leached from the surface layer and subsoil. A distinct horizon of carbonate accumulation is at a depth of 24 to 35 inches.

Datwyler soils are used for range, watershed, and wildlife habitat.

Datwyler cobbly silty clay loam, 30 to 60 percent slopes (D1G).—This soil is in south-facing mountain areas, mainly south and west of the town of Wellsville.

Representative profile, located 3 miles south of Wellsville, 300 feet west and 1,000 feet south of the north quarter corner of sec. 27, T. 10 N., R. 1 W:

- A1—0 to 4 inches, brown (7.5YR 4/2) cobbly heavy silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky and plastic; common fine and medium roots; 40 to 50 percent cobblestones and gravel; neutral; clear, wavy boundary.
- B1—4 to 11 inches, brown (7.5YR 4/2) very cobbly clay, dark brown (7.5YR 3/2) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; common fine and medium interstitial and tubular pores; 60 percent cobblestones and gravel; neutral; clear, wavy boundary.
- B2t—11 to 28 inches, reddish-brown (5YR 5/4) very cobbly clay, reddish-brown (5YR 4/4) when moist; moderate, medium, prismatic structure that parts to strong, medium, subangular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine roots; few fine interstitial pores; thin continuous clay films; 70 percent cobblestones and gravel; neutral; clear, wavy boundary.
- Cca—28 to 35 inches, pink (7.5YR 7/4) very cobbly sandy clay loam, light brown (7.5YR 6/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; 90 percent cobblestones and gravel; strongly calcareous; mildly alkaline.
- R—35 inches, fractured limestone bedrock that has streaks of lime in cracks and on rocks.

The A1 horizon ranges from brown to dark brown in a hue of 10YR or 7.5YR. Texture ranges from cobbly heavy silty

clay loam to cobbly heavy loam. Reaction is slightly acid to neutral. Thickness ranges from 4 to 10 inches. The B1 horizon ranges from brown to dark brown. Texture is very cobbly heavy clay loam or very cobbly clay. The B2t horizon ranges from reddish brown to brown or strong brown in a dominant hue of 5YR or 7.5YR. Texture is dominantly very cobbly clay but ranges to very cobbly heavy clay loam. Reaction is slightly acid to neutral. The Cca horizon ranges from pink to light brown in a hue of 7.5YR or 5YR. Reaction ranges from mildly alkaline to strongly alkaline. The depth to limestone bedrock ranges from 32 to 40 inches. Pebbles and cobblestones are present throughout the profile and generally increase with depth. The content of coarse fragments ranges from 30 to 50 percent in the A1 horizon, 40 to 60 percent in the B1 horizon, 50 to 80 percent in the B2t horizon, and 70 to 95 percent in the C horizon.

Permeability is moderately slow. Runoff is rapid to very rapid and the hazard of erosion is high to very high. This soil holds 3 to 5 inches of available water above the bedrock. Most roots are above the bedrock, but some extend into cracks to depths of 4 feet or more.

Included in mapping were small areas of Sheep Creek cobbly loam, 30 to 70 percent slopes, and Agassiz cobbly silt loam, 30 to 60 percent slopes.

This Datwyler soil is used for range, watershed, and wildlife habitat. (Capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Datwyler-Elzinga-Maughan association (30 to 60 percent slopes) (DNG).—This mapping unit consists of soils in the foothills of mountains south of Wellsville and in areas on the north end of Wellsville Mountain. About 40 percent of the association is Datwyler cobbly silty clay loam; 30 percent is Elzinga silt loam, 30 to 60 percent slopes; 20 percent is Maughan silt loam, 30 to 60 percent slopes; and 10 percent is included soils.

The Datwyler soil mainly has slopes that face south, and the vegetation is mostly bluebunch wheatgrass, cheatgrass, sagebrush, balsamroot, bitterbrush, and yellowbrush. The Datwyler soil in this mapping unit is similar to Datwyler cobbly silty clay loam, 30 to 60 percent slopes.

The Elzinga and Maughan soils are very steep and mostly have slopes that face north. The Maughan soil is described under the Maughan series. Vegetation on these soils is dominantly maple, but there are scattered aspen trees and a sparse understory of chokecherry, wheatgrass, false Solomons-seal, and fern.

Included in mapping were areas of deep, gravelly, medium-textured soils that formed in alluvium.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Datwyler soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site. Elzinga and Maughan soils are in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site. None of these soils is in a woodland suitability group. All are in wildlife suitability group 3)

Despain Series

The Despain series consists of well-drained soils that formed in residuum and colluvium derived from sandstone, quartzite, and limestone. These soils are in dominantly south- and west-facing mountain areas. In the Clarkston Mountain area, however, slopes face east and north. Elevations range from 5,500 to 8,000 feet. Slopes range from 20 to 70 percent. The vegetation is bluebunch

wheatgrass, tall native bluegrass, big sagebrush, yellow-brush, bitterbrush, ceanothus, ninebark, and serviceberry. The average annual precipitation is 20 to 25 inches, the mean annual temperature is 38° to 44° F., and the frost-free season is 80 to 100 days. Despain soils are associated with Ant Flat, Lucky Star, Bickmore, and Sheep Creek soils.

In a representative profile, the surface layer is brown to dark-brown, slightly acid to neutral gravelly loam about 16 inches thick. The subsoil is brown to dark-brown, neutral gravelly clay loam about 14 inches thick. The substratum, to a depth of 60 inches or more, is reddish-yellow, strongly calcareous, mildly alkaline gravelly loam. Carbonates have been leached from the surface layer and upper part of the subsoil and redeposited in the lower part of the subsoil and the substratum.

Despain soils are used for range, wildlife habitat, and watershed.

Despain-Lucky Star association (30 to 70 percent slopes) (DSG).—This mapping unit consists of soils on mountains east of Ant Flat. About 60 percent of the association is Despain gravelly loam, 30 to 70 percent slopes; 30 percent is Lucky Star gravelly silt loam, 30 to 60 percent slopes; and about 10 percent is included soils.

The Despain soil is in broad, open, west- and south-facing areas, where the vegetation is shrubs and grasses. The Lucky Star soil is in north- and east-facing areas. Here, the vegetation is aspen.

Representative profile of Despain gravelly loam, 30 to 70 percent slopes, in an area of Despain-Lucky Star association, 8 miles south of Hardware Ranch and 1 mile east of the road, 200 feet west of the east quarter corner of sec. 26, T. 9 N., R. 3 E.:

- A11—0 to 9 inches, brown to dark-brown (7.5YR 4/3) gravelly loam, very dark brown (7.5YR 2/2) when moist; weak, fine, granular structure; soft, very friable, non-sticky and slightly plastic; many fine, medium, and large roots; 20 percent gravel and cobblestones; slightly acid; gradual, wavy boundary.
- A12—9 to 16 inches, brown to dark-brown (7.5YR 4/3) gravelly loam, very dark brown (7.5YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; slightly hard, very friable, nonsticky and slightly plastic; many fine, medium, and large roots; many, fine, random, interstitial pores; 20 percent gravel and cobblestones; neutral; gradual, wavy boundary.
- B21t—16 to 23 inches, brown to dark-brown (7.5YR 4/3) gravelly light clay loam, very dark brown (7.5YR 2/2) when moist; moderate, medium and coarse, subangular blocky structure that parts to weak, fine, subangular blocky structure; slightly hard, firm, slightly sticky and plastic; many fine and medium roots; many, fine, random, interstitial pores; thin continuous clay films; 30 percent gravel and cobblestones; neutral; gradual, wavy boundary.
- B22t—23 to 30 inches, brown (7.5YR 5/4) gravelly light clay loam, dark brown (7.5YR 3/2) when moist; weak, coarse, subangular blocky structure that parts to weak, fine, subangular blocky structure; slightly hard, firm, slightly sticky and plastic; common fine and medium roots; many, fine, random, interstitial pores; common thin clay films; 30 percent gravel and cobblestones; neutral; gradual, wavy boundary.
- Cca—30 to 60 inches, reddish-yellow (5YR 6/6) gravelly heavy loam, yellowish red (5YR 4/6) when moist; massive; slightly hard, firm, nonsticky and slightly plastic; few fine and medium roots; many fine pores; 40 percent gravel and cobblestones; strongly calcareous; mildly alkaline.

The combined thickness of the A1 and B2t horizons ranges from 24 to 38 inches over the Cca horizon. The A1 horizon ranges from brown to dark brown or reddish brown in a hue of 10YR, 7.5YR, or 5YR. This horizon ranges from gravelly loam to loam and is 10 to 30 percent gravel and cobblestones. Reaction ranges from slightly acid to mildly alkaline. Thickness ranges from 12 to 17 inches. The B2t horizon ranges from brown or dark brown to yellowish brown or reddish brown in a hue of 10YR, 7.5YR, or 5YR. Texture is cobbly and gravelly light clay loam or cobbly and gravelly heavy loam. Reaction is slightly acid to mildly alkaline. Thickness ranges from 8 to 20 inches. The Cca and C horizons range from reddish yellow to yellowish brown or brown in hues of 10YR to 5YR. Texture ranges from cobbly and gravelly loam to very cobbly and gravelly clay loam. Reaction is mildly alkaline to moderately alkaline. These horizons are moderately calcareous to strongly calcareous.

Permeability is moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. This soil holds 6 to 9 inches of available water to a depth of 5 feet. Roots extend to a depth of 4 feet or more.

Included in mapping were areas of Scave silt loam, 10 to 30 percent slopes, and Sheep Creek cobbly loam, 30 to 70 percent slopes. The Scave soil is in north- and east-facing areas, where the vegetation is aspen. The Sheep Creek soil is in west-facing areas, where the vegetation is shrubs and grasses.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Despain soil is in capability unit VIIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3. Lucky Star is in capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2r1; wildlife suitability group 4)

Despain-Bickmore association (30 to 70 percent slopes) (DPG).—This mapping unit is on the east side of Clarkston Mountain. About 50 percent of it is Despain gravelly loam, 30 to 70 percent slopes; 35 percent is Bickmore gravelly silt loam, 30 to 60 percent slopes; and about 15 percent is included soils.

The Despain soil is in open areas, where the vegetation is brush, forbs, and grasses. The vegetation on the Bickmore soil is a dense stand of conifers but only a sparse understory.

Included in mapping were areas of Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, Picayune gravelly loam, 50 to 80 percent slopes, and Smarts gravelly loam, 30 to 70 percent slopes.

Soils of this mapping unit are used for range, wildlife habitat, and watershed. (Despain soil is in capability unit VIIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3. Bickmore soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Elwood Series

The Elwood series consists of well-drained soils that formed in residuum derived chiefly from limestone. These soils are on mountains at elevations of 7,500 to 9,000 feet. Slopes range from 10 to 60 percent. The vegetation is Douglas-fir, alpine fir, and Engelmann spruce. The average annual precipitation is 25 to 35 inches, the mean an-

nual temperature is 32° to 42° F., and the mean soil temperature in summer is less than 60°. The frost-free season is 75 to 90 days. Elwood soils are associated with Mult, Dateman, and Agassiz soils.

In a representative profile, the surface layer is brown, medium acid heavy silt loam about 11 inches thick. The subsoil is brown, neutral cobbly and very cobbly silty clay loam about 27 inches thick. Fractured limestone is at a depth of about 38 inches.

The Elwood soils are used mainly for watershed and wildlife habitat. Wood products have been harvested in a few places.

Elwood silt loam, 30 to 60 percent slopes (EDG).—This soil is in dominantly north- and east-facing areas near the head of Paradise Dry Canyon and also in the vicinity of Beaver Mountain.

Representative profile, 2 miles south and 1 mile east of Beaver Mountain, about 2,000 feet north and 2,000 feet east of the southwest corner of sec. 20, T. 14 N., R. 4 E.:

O1—2 inches to 0, fir needles and twigs.

A1—0 to 11 inches, brown (10YR 5/3) heavy silt loam, dark brown (7.5YR 3/3) when moist; moderate, medium, subangular blocky structure that parts to moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots and few large roots; few, fine, discontinuous, random, impeded pores; medium, acid; clear, wavy boundary.

B21t—11 to 26 inches, brown (7.5YR 5/4) cobbly silty clay loam, brown to dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard, firm, sticky and slightly plastic; common fine and medium roots; few, fine, discontinuous, random, impeded pores; common thin clay films in pores and on ped surfaces; 20 percent cobblestones; neutral; clear, wavy boundary.

B22t—26 to 38 inches, brown (7.5YR 5/4) very cobbly light silty clay loam, brown to dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and medium roots; few fine pores; common thin clay films; 80 percent cobblestones and gravel-size limestone rock fragments; neutral.

R—38 inches, fractured limestone.

The A1 horizon ranges from brown to dark brown in a hue of 10YR or 7.5YR. This horizon is dominantly heavy silt loam but is loam in places and has a gravel content of 5 to 20 percent. Reaction is slightly acid to medium acid. Thickness ranges from 10 to 12 inches. The B2t horizon ranges from brown to pale brown or light brown in a hue of 10YR or 7.5YR. Its texture ranges from cobbly silty clay loam to cobbly heavy loam in the upper part of the horizon to very cobbly silty clay loam in the lower part. The content of cobblestones and gravel is 20 to 50 percent in the upper part of the horizon and 50 to 80 percent in the lower part. Depth to bedrock is 20 to 40 inches.

Permeability is moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. This soil holds 4 to 6 inches of available water above the bedrock. Roots are mostly above the limestone, but some roots extend into cracks in the rocks.

Included in mapping were areas of moderately deep, well-drained silty clay loam soils and areas of Agassiz rocky loam, 30 to 70 percent slopes, eroded. The silty clay loams make up 7 percent of the mapping unit, and the Agassiz soil makes up 3 percent.

This Elwood soil is used for watershed, woodland, and wildlife habitat. (Capability unit VIIe-HC, nonirrigated;

High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Elwood-Agassiz association (6 to 30 percent slopes) (EGE).—This mapping unit is in broken areas near the crest of mountains at the head of Hyrum Dry Canyon. Slopes are dominantly 10 to 20 percent. The rock formations are tilted, and the rocky ridges are long and narrow. These ridges are generally oriented in a north-south direction. About 55 percent of the association is Elwood silt loam, 10 to 30 percent slopes; 35 percent is Agassiz rocky silt loam, 6 to 30 percent slopes; and 10 percent is included soils.

The Elwood soil is in pockets and somewhat concave areas between rocky ridges. The depth to limestone bedrock is 28 to 40 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

The Agassiz soil is on the southern and southwestern exposures of ridges. The vegetation is big sagebrush and some curleaf mountain-mahogany.

Included in mapping were areas of Goring silt loam, 6 to 8 percent slopes, and Obay silty clay loam, 6 to 20 percent slopes. The Goring soil is on southwestern exposures and has a cover of big sagebrush and snowberry. The Goring soil makes up about 8 percent of the mapping unit and Obay soil 2 percent.

The soils of this mapping unit are used for range, woodland, watershed, and wildlife habitat. (Elwood soil is in capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Elwood-Mult association, hilly (6 to 30 percent slopes) (EME).—This mapping unit consists of moderately steep soils on mountains east of the Logan River, near Beaver Mountain in the Franklin Basin area. The underlying rock formations are limestone and a small amount of interbedded quartzite. About 70 percent of the association is Elwood silt loam, 10 to 30 percent slopes; 20 percent is Mult silt loam, 6 to 30 percent slopes; and 10 percent is included soils.

The Elwood soil has slopes that mainly face north and east, where the vegetation is Douglas-fir and alpine fir. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Depth to limestone bedrock ranges from 28 to 40 inches.

The Mult soil has slopes that mainly face south and west. Here, the vegetation is aspen.

Included in mapping were areas of Agassiz rocky silt loam, 6 to 30 percent slopes. This soil has dominantly southern and western exposures, and vegetation on the ridges is big sagebrush.

Soils of this mapping unit are used for watershed, range, woodland, and wildlife habitat. (Elwood soil is in capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4. Mult soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4)

Elwood-Mult association, steep (30 to 60 percent slopes) (EMG).—This mapping unit lies both east and west

of the Logan River in the Franklin Basin and Beaver Mountain area. The soils have all exposures in the mountains. About 70 percent of the association is Elwood silt loam, 30 to 60 percent slopes; 20 percent is Mult silt loam, 30 to 50 percent slopes; and about 10 percent is included soils.

The Elwood soil has slopes that face north and east, and the vegetation on it is conifers. The Mult soil is in concave areas or small basins, and the vegetation on it is aspen.

Included in mapping were small areas of Agassiz rocky silt loam, 30 to 70 percent slopes, eroded, and Bradshaw silt loam, 30 to 60 percent slopes. The Agassiz soil is on the ridges, where the vegetation is mostly big sagebrush and low sagebrush. The Bradshaw soil is in basins under snowberry and ceanothus.

The soils of this mapping unit are used for watershed, range, woodland, and wildlife habitat. (Elwood soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4. Mult soil is in capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2r1; wildlife suitability group 4)

Elzinga Series

The Elzinga series consists of well-drained soils that formed in residuum and colluvium derived from sandstone and limestone. These soils are on dominantly north- and east-facing mountains at elevations of 5,000 to 7,500 feet. Slopes range from 10 to 60 percent. The vegetation is maple and scattered aspen and an understory of mountain brome, slender wheatgrass, and forbs. The average annual precipitation is 20 to 25 inches, the mean annual temperature is 42° to 45° F., and the frost-free season is 90 to 110 days. Elzinga soils are associated with Maughan, Datwyler, Sheep Creek, and Agassiz soils.

In a representative profile, the surface layer is very dark gray, slightly acid silt loam about 22 inches thick. The subsurface layer is brown to pale-brown, slightly acid silt loam and cobbly silt loam about 26 inches thick. The next layer is pale-brown to dark-brown, slightly acid very cobbly very fine sandy loam to a depth of 60 inches or more.

Elzinga soils are used for watershed, range, and wildlife habitat.

Representative profile of Elzinga silt loam, 30 to 60 percent slopes, in an area of Datwyler-Elzinga-Maughan association, 3 miles south of Wellsville, 1,200 feet south and 2,000 feet east of the northwest corner of sec. 27, T. 10 N., R. 1 W.:

O1—1 inch to 0, partially decomposed leaves and twigs.

A1—0 to 22 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, fine and medium, granular structure; soft, friable, slightly sticky and slightly plastic; many fine, medium, and large roots; slightly acid; gradual, smooth boundary.

A21—22 to 26 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine and medium interstitial pores; slightly acid; clear, smooth boundary.

A22—26 to 48 inches, pale-brown (10YR 6/3) cobbly silt loam, brown to dark brown (10YR 4/3) when moist; massive; slightly hard, friable, sticky and slightly plastic;

many fine and medium roots; many fine and medium interstitial pores; 30 percent cobbles and gravel; slightly acid; gradual, smooth boundary.

A2&B2t—48 to 62 inches, about 70 percent A2 horizon and 39 percent B2t horizon. The A2 part is pale-brown (10YR 6/3) very cobbly very fine sandy loam, brown to dark brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic. The B2t part is brown (7.5YR 5/4) very cobbly clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; many fine and medium interstitial pores; thin continuous clay films; 60 percent cobbles and gravel; slightly acid; gradual, wavy boundary.

R—62 inches, fractured sandstone; material from B2t horizon extends in cracks; more than 90 percent sandstone rock.

The O1 horizon ranges from ½ inch to 2 inches in thickness. The combined thickness of the A1, A2, and B2t horizons is more than 60 inches. Coarse fragments are mostly cobbles and gravel-size, angular sandstone rock fragments; their content ranges from 30 to 50 percent in the upper A2 horizon and 50 to 60 percent in the lower A2 and B2t horizons. The A1 horizon ranges from very dark gray to very dark grayish brown in a hue of 10YR. This horizon is dominantly silt loam but ranges to loam and is as much as 15 percent gravel. Reaction is slightly acid to medium acid. Thickness ranges from 20 to 28 inches. The A2 horizon has a hue of 10YR or 7.5YR. Texture ranges from silt loam or cobbly silt loam to cobbly very fine sandy loam. Reaction is slightly acid to medium acid. The A2 horizon tongues into the B2t horizon. The B2t horizon ranges from brown to light brown. It ranges from very cobbly clay loam to very cobbly loam and is 50 to 60 percent cobbles and gravel. Reaction is slightly acid to medium acid.

Permeability of the Elzinga soils is moderate to moderately rapid. Runoff is rapid or very rapid, and the hazard of erosion is high or very high. These soils hold from 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate readily to a depth of 5 feet or more.

In this survey area, Elzinga soils are not mapped separately but are mapped only in associations with Datwyler, Maughan, and Hoskin soils.

Fitzgerald Series

The Fitzgerald series consists of well-drained soils that formed in residuum, colluvium, and glacial till materials derived from quartzite and some limestone. These soils are in dominantly north-facing mountain areas at elevations of 7,300 to 8,500 feet. Slopes range from 10 to 20 percent. The vegetation is Douglas-fir, alpine fir, and Engelmann spruce and an understory of shrubs and grasses. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is 34° to 40° F., and the mean soil temperature in summer is less than 60°. The frost-free season is 70 to 80 days. Fitzgerald soils are associated with Lucky Star, Scout, and Elwood soils.

In a representative profile, the surface layer is brown, strongly acid extremely stony loam about 8 inches thick. The subsurface layer is brown, strongly acid gravelly loam about 17 inches thick. The subsoil is pale-brown, strongly acid very gravelly sandy clay loam about 12 inches thick. The substratum, to a depth of 60 inches or more, is light brownish-gray, medium acid very gravelly fine sandy loam.

Fitzgerald soils are used for watershed, woodland, range, and wildlife habitat.

Fitzgerald extremely stony loam, 10 to 20 percent slopes (FGD).—This soil is on mountain foot slopes in the Franklin Basin area.

Representative profile, one-fourth mile north of Crescent Lake, 1,280 feet north of the southeast corner of sec. 5, T. 14 N., R. 3 E.:

O1—1 inch to 0, needles and twigs.

A1—0 to 8 inches, brown (10YR 4/3) extremely stony loam, dark brown (10YR 3/3) when moist; weak, medium, granular structure; slightly hard, friable, nonsticky and slightly plastic; common fine and medium roots and few large roots; 10 percent cobblestones and gravel and 5 percent stones; strongly acid; clear, wavy boundary.

A2—8 to 18 inches, brown (10YR 5/3) gravelly light loam, dark brown to brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure that parts to moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots and few large roots; 20 percent cobblestones and gravel and 5 percent stones; strongly acid; gradual, wavy boundary.

A2&B2t—18 to 25 inches, 60 percent is similar to the A2 horizon, except that it is more cobbly, and 40 percent is the same as the B2t horizon.

B2t—25 to 37 inches, pale-brown (10YR 6/3) very gravelly sandy clay loam, brown (10YR 5/3) when moist; weak, medium and fine, subangular blocky structure; hard, firm, slightly sticky and plastic; common thin clay films on peds and in pores; 65 percent cobblestones and gravel and 5 percent stones; strongly acid; gradual, wavy boundary.

IIC1—37 to 60 inches, light brownish-gray (10YR 6/2) very gravelly fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 70 percent gravel and cobblestones and a few stones; medium acid.

The A1 horizon ranges from brown to dark brown in a hue of 10YR or 7.5YR. Reaction is medium acid to strongly acid. Thickness ranges from 6 to 9 inches. Stone content ranges from 5 to 15 percent. The A2 horizon ranges from brown to pale brown or very pale brown in a hue of 10YR or 7.5YR. Texture ranges from gravelly sandy loam or gravelly light loam to extremely stony sandy loam or very cobbly sandy loam. The A2 horizon is 20 to 70 percent gravel and cobblestones and is as much as 5 percent stones in places. Thickness ranges from 9 to 16 inches. The B2t horizon ranges from pale brown to brown in a hue of 10YR or 7.5YR. Texture ranges from very gravelly sandy clay loam to extremely stony sandy clay loam or very gravelly heavy loam. The B2t horizon is 50 to 70 percent cobblestones and gravel and is as much as 5 percent stones in places.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight. This soil holds 5 to 7.5 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Included in mapping were areas of Goring silt loam, 6 to 30 percent slopes. This included soil makes up about 2 percent of the total acreage.

This Fitzgerald soil is used for range, woodland, watershed, and wildlife habitat. (Capability unit VII_s-HXC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4x1; wildlife suitability group 4)

Flygare Series

The Flygare series consists of well-drained soils that formed in alluvium and colluvium derived from quartzite sandstone and limestone. These soils are alluvial fans, old flood plains, and moraines at elevations of 6,300 to

8,000 feet. Slopes range from 3 to 20 percent. The vegetation is aspen and an understory of slender wheatgrass, Sandberg bluegrass, mulesear dock, big sagebrush, elderberry, and chokecherry. The average annual precipitation is 25 to 30 inches, the mean annual air temperature is 36° to 40° F., and the mean soil temperature in summer is less than 60°. The frost-free season is 70 to 90 days. Flygare soils are associated with Lucky Star, Goring, and Yeates Hollow soils.

In a representative profile, the surface layer is dark grayish-brown and grayish-brown, slightly acid silt loam and cobbly silt loam about 27 inches thick. The subsurface layer is light yellowish-brown, medium acid very cobbly very fine sandy loam about 12 inches thick. The subsoil is light yellowish-brown, medium acid cobbly sandy clay loam about 8 inches thick. The substratum, to a depth of 60 inches or more, is pale-brown, slightly acid very cobbly heavy sandy loam.

Flygare soils are used for range, watershed, and wildlife habitat.

Flygare silt loam, 3 to 20 percent slopes (FID).—This soil is on slightly convex, old flood plains and alluvial fans near the Logan River in the Franklin Basin area.

Representative profile, 720 feet west and 1,360 feet north of the southeast corner of sec. 23, T. 14 N., R. 3 E.:

A11—0 to 13 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine roots, common medium roots; and few large roots; slightly acid; clear, smooth boundary.

A12—13 to 27 inches, grayish-brown (10YR 5/2) cobbly silt loam, dark brown (10YR 3/3) when moist; weak, coarse, subangular blocky structure that parts to moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots, common medium roots, and few large roots; 30 percent cobblestones and stones; slightly acid; abrupt, irregular boundary.

A2—27 to 39 inches, light yellowish-brown (10YR 6/4) very cobbly very fine sandy loam, brown (7.5YR 4/3) when moist; weak, fine, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine and medium roots; 40 percent cobblestones and about 5 percent stones; medium acid; clear, irregular boundary.

B2t—39 to 47 inches, light yellowish-brown (10YR 6/4) cobbly sandy clay loam, brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few fine and medium roots; common thin clay films; about 40 percent cobblestones and 2 to 3 percent stones; medium acid; clear, wavy boundary.

C1—47 to 65 inches, pale-brown (10YR 6/3) very cobbly heavy sandy loam, brown (7.5YR 4/4) when moist; massive; slightly hard, loose, very friable, slightly sticky and nonplastic; few fine and medium roots; 60 percent cobblestone and gravel; slightly acid.

The A1 horizon ranges from dark grayish brown or grayish brown to brown in a hue of 10YR or 7.5YR. Texture is loam to silt loam or cobbly silt loam. Reaction is strongly acid to slightly acid. Thickness ranges from 21 to 30 inches. The A2 horizon ranges from light yellowish brown or brown to pale brown in a hue of 10YR or 7.5YR. Texture ranges from cobbly light loam to very cobbly sandy loam. Reaction is slightly acid to medium acid. Thickness ranges from 9 to 12 inches. A mixed A2 and B2t horizon is present in places where the A2 horizon extends into the B2t horizon. The B2t horizon ranges from light yellowish brown to brown or pale brown in hues of 10YR and 7.5YR. Texture range from cobbly sandy clay loam to gravelly clay loam. The C horizon ranges from

pale brown to yellowish brown or brown in hues of 10YR and 7.5YR. Texture ranges from very cobbly sandy loam to very cobbly light loam.

Permeability is moderate. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 6 to 8 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Included in mapping were small areas of an extremely stony soil.

This Flygare soil is used entirely for range, watershed, and wildlife habitat. (Capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4)

Foxol Series

The Foxol series consists of somewhat excessively drained soils that formed in residuum and colluvium derived from quartzite. These steep and very steep soils are on mountains at elevations of 6,500 to 7,500 feet. Slopes range from 30 to 60 percent. The vegetation is dominantly bluebunch wheatgrass, native bluegrass, low sagebrush, buckwheat, serviceberry, bitterbrush, yarrow, and scattered chokecherry. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 38° to 41° F., and the frost-free season is 80 to 90 days. Foxol soils are associated with Yeates Hollow, Lucky Star, Agassiz, and Hoskin soils.

In a representative profile, the soil is brown and light-brown, slightly acid and medium acid gravelly loam, very gravelly loam, and very gravelly sandy loam about 17 inches thick. Bedrock is at a depth of about 17 inches.

Foxol soils are used for range, watershed, and wildlife habitat.

Foxol rocky loam, 30 to 60 percent slopes (FOG).—This steep to very steep soil is on mountains near Scare Canyon, at the head of the Little Bear River drainage above Mineral Point.

Representative profile one-fourth mile east of old mine at Mineral Point, about 1,600 feet south of the northwest corner of sec. 30, T. 9 N., R. 3 E. (profile described between rock outcrops):

A1—0 to 7 inches, brown (7.5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, granular structure; soft, friable, nonsticky and nonplastic; many fine, medium, and large roots; 30 percent gravel and cobblestones; slightly acid; clear, wavy boundary.

B2—7 to 11 inches, brown (7.5YR 5/4) very gravelly loam, reddish brown (5YR 4/3) when moist; moderate, fine, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 60 percent gravel and cobblestones; slightly acid; abrupt, wavy boundary.

C—11 to 17 inches, light-brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) when moist; massive; loose, nonsticky and nonplastic; few fine and medium roots; many fine and medium pores; 70 percent gravel and cobblestones; medium acid; abrupt, irregular boundary.

R—17 inches, fractured, weathering quartzite rock.

The A1 horizon ranges from brown to reddish brown in hues of 7.5YR and 5YR. Thickness ranges from 7 to 12 inches. The B2 horizon ranges from brown to light reddish brown in a hue of 7.5YR or 5YR. Texture ranges from very gravelly loam to very gravelly heavy sandy loam. Structure is weak to moderate, fine to coarse, subangular blocky. Reaction is

slightly acid to medium acid. Thickness ranges from 4 to 11 inches. The C horizon ranges from light brown to pink in a hue of 7.5YR or 5YR. Texture ranges from very gravelly loam to very gravelly sandy loam. Reaction is slightly acid to medium acid. The coarse fragments are mainly cobblestones and gravel-size angular quartzite fragments. These fragments make up 20 to 50 percent of the A horizon and 50 and 80 percent of the B2 and C horizons.

Permeability is moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. This soil holds 2 to 3.5 inches of available water above the bedrock. Roots are mostly in the surface layer, 14 to 20 inches above the quartzite bedrock, but some roots extend into cracks in the rocks.

Included in mapping were areas of Yeates Hollow extremely stony silt loam, 30 to 70 percent slopes, and areas of rock outcrop. The Yeates Hollow soil makes up about 2 percent of the total acreage, and the rock outcrop 5 to 8 percent.

This Foxol soil is used for range, watershed, and wildlife habitat. (Capability unit VIIi-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Goring Series

The Goring series consists of well-drained soils that formed in colluvium and residuum derived from sandstone, quartzite, and small amounts of limestone. These soils are on mountains at elevations of 5,300 to 7,200 feet. Slopes range from 3 to 60 percent. The vegetation is bluebunch wheatgrass, tall native bluegrass, Great Basin wildrye, prairie junegrass, Columbia needlegrass, yarrow, lupine, yellowbrush, bitterbrush, and big sagebrush. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 38° to 42° F., and the frost-free season is 80 to 100 days. Goring soils are associated with Agassiz, Yeates Hollow, Obray, Curtis Creek, Hoskin, Scave, and Lucky Star soils.

In a representative profile, the surface layer is brown, slightly acid silt loam about 7 inches thick. The upper part of the subsoil is brown and reddish-brown, slightly acid silty clay about 28 inches thick. The lower part of the subsoil is red, slightly acid silty clay loam to a depth of 60 inches or more.

Goring soils are used for range, watershed, and wildlife habitat. Some small areas formerly were cultivated, but are now seeded to grasses. These soils are not suited to cultivated crops, because of the frost hazard.

Goring silt loam, 6 to 30 percent slopes (GGE).—This soil is in the mountains, mainly in the Hardware Ranch-Ant Flat area. Some of the acreage is in the Logan River and Little Bear River drainage areas.

Representative profile, about 2½ miles northeast of Hardware Ranch headquarters, about 1,000 feet south and 1,400 feet west of the northeast corner of sec. 7, T. 10 N., R. 4 E.:

A11—0 to 3 inches, brown (10YR 4/3) silt loam, dark brown (10YR 3/3) when moist; weak, thick, platy structure; soft, friable, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt, wavy boundary.

A12—3 to 7 inches, brown (10YR 4/3) silt loam, dark brown (10YR 3/3) when moist; moderate, fine and medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; slightly acid; clear, wavy boundary.

- B1**—7 to 13 inches, brown (7.5YR 4/3) light silty clay loam, dark brown (7.5YR 3/3) when moist; moderate, medium and fine, angular blocky structure; hard, firm, friable, sticky and plastic; many fine roots; common, fine, discontinuous, interstitial pores; slightly acid; clear, wavy boundary.
- B21t**—13 to 22 inches, reddish-brown (5YR 4/3) heavy silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, coarse, prismatic structure that parts to fine and medium, angular blocky structure; very hard, firm, sticky and plastic; common fine roots; common, fine, discontinuous, interstitial pores; moderately thick continuous clay films; slightly acid; diffused, wavy boundary.
- B22t**—22 to 35 inches, reddish-brown (5YR 4/4) silty clay, yellowish red (5YR 4/6) when moist; strong, coarse, subangular blocky structure that parts to medium and fine, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine roots; common, fine, discontinuous, interstitial pores; moderately thick continuous clay films; slightly acid; diffused, wavy boundary.
- B23t**—35 to 60 inches, red (2.5YR 4/6) heavy silty clay loam, dark red (2.5YR 2/6) when moist; moderate, coarse, subangular blocky structure that parts to fine and medium, subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; common, fine, discontinuous pores; moderately thick continuous clay films; slightly acid.

The A1 horizon ranges from brown to dark brown in a hue of 10YR or 7.5YR. Texture ranges from silt loam to clay loam. Reaction is slightly acid to neutral. Thickness ranges from 7 to 14 inches. The B1 horizon ranges from brown to reddish brown in a hue of 5YR, 7.5YR, or 10YR. Texture ranges from silt loam to light silty clay loam. The B1 horizon is 10 to 20 percent gravel and cobblestones in places. Reaction is slightly acid to neutral. Thickness ranges from 3 to 11 inches. The B2t horizon ranges from reddish brown to strong brown or red in a hue of 7.5YR, 5YR, or 2.5YR. Texture ranges from clay or silty clay to heavy silty clay loam.

The soil is fairly easy to till. Permeability is slow. Runoff is slow to moderate, and the hazard of erosion is slight to moderate. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more, but most roots are above the silty clay horizon.

Included in mapping were small areas of Ant Flat loam, 6 to 20 percent slopes; O Bray silty clay, 6 to 20 percent slopes; Curtis Creek loam, 10 to 30 percent slopes; and Yeates Hollow extremely stony silt loam, 6 to 30 percent slopes. These inclusions together make up about 8 percent of the mapping unit.

This Goring soil generally is used for range, watershed, and wildlife habitat. Some areas formerly were cultivated but now are mostly reseeded to grasses. Cultivated crops are severely limited because of the frequent frosts late in spring or early in summer. Small grain and alfalfa are grown. None of the acreage is irrigated. (Capability unit VIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Goring-O Bray association, eroded (3 to 30 percent slopes) (GOE2).—This mapping unit is west of the Little Bear River, between McMurdie Hollow and Three-Mile Canyon, and also in the Ant Flat and Bear Flat areas south of Hardware Ranch. These gently sloping to steep soils are on broad, gently rolling mountain ridges and eroded old alluvial fans or terraces. About 45 percent of the association is Goring clay loam, 3 to 30 percent slopes, eroded; 25 percent is O Bray silty clay, 6 to 20

percent slopes, eroded; 25 percent is Yeates Hollow extremely stony silty clay loam, 3 to 30 percent slopes, eroded; and 5 percent is included soils.

The Goring soil is similar to Goring silt loam, 6 to 30 percent slopes, except that it is moderately eroded and its surface layer is clay loam only 6 to 10 inches thick. Also, the horizon of clay accumulation is at a depth of only 8 to 15 inches. Runoff is medium, and the hazard of erosion is moderate. The vegetation is low sagebrush, mulesear dock, slender wheatgrass, and western wheatgrass.

Included in mapping were areas of Sheep Creek cobbly loam, 30 to 70 percent slopes.

Soils of this association are essentially all used for range, watershed, and wildlife habitat. (Goring soil is in capability unit VIe-M5, nonirrigated; Mountain Clay range site. O Bray soil is in capability unit VIe-M5, nonirrigated; Mountain Clay range site. Yeates Hollow soil is in capability unit VIIe-MX5, nonirrigated; Mountain Stony Clay range site. None of the soils is in a woodland suitability group; all soils are in wildlife suitability group 3)

Gravel Pit

Gravel pit (Gp) is a miscellaneous land type that consists of open excavations from which sand and gravel have been removed. Most of the material has been used in building construction and for road subgrade and surfacing. An area near the Hyrum and Newton dams was used as earthfill during their construction. Most of these pits are still in operation and have no farming value. (Capability unit VIIIe-4, nonirrigated; not in a range site, woodland suitability group, or wildlife suitability group)

Green Canyon Series

The Green Canyon series consists of somewhat excessively drained soils that formed in very strongly calcareous alluvium derived from dolomitic limestone. These soils are on alluvial fans deposited on intermediate and high lake terraces at elevations of 4,500 to 5,100 feet. Slopes range from 0 to 7 percent. The vegetation is big sagebrush, gumweed, bluebunch wheatgrass, native bluegrass, and cheatgrass. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 46° to 49° F., and the frost-free season is 130 to 150 days. Green Canyon soils are associated with Millville, Steed, Sterling, and Ricks soils.

In a representative profile, the surface layer is dark grayish-brown to brown, moderately alkaline gravelly loam about 16 inches thick. The next layer is brown, moderately alkaline, very strongly calcareous very gravelly fine sandy loam about 7 inches thick. This is underlain by light brownish-gray, moderately alkaline, very strongly calcareous very gravelly loamy sand that extends to a depth of 60 inches or more.

Green Canyon soils are used mostly for irrigated cropland. Alfalfa, small grain, and improved pasture are the principal crops.

Green Canyon gravelly loam, 3 to 7 percent slopes (GrB).—This soil is on the upper part of alluvial fans

formed at the mouth of Green Canyon east of North Logan. The Green Canyon Forest Nursery is located on this soil. The topography is slightly undulating.

Representative profile, 550 feet east of Green Canyon Forest Nursery shed, 500 feet north and 500 feet west of the center of sec. 24, T. 12 N., R. 1 E.:

- A11—0 to 9 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; 20 percent gravel; strongly calcareous; moderately alkaline; gradual, smooth boundary.
- A12—9 to 16 inches, brown to dark-brown (7.5YR 4/2) gravelly loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; 20 percent gravel; strongly calcareous; moderately alkaline; clear, smooth boundary.
- C1—16 to 23 inches, brown (10YR 5/3) very gravelly fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; common fine pores; 50 percent gravel; very strongly calcareous; moderately alkaline; clear, wavy boundary.
- IIC2—23 to 60 inches, light brownish-gray (10YR 6/2) very gravelly loamy sand, grayish brown (10YR 5/2) when moist; massive; loose, nonsticky and nonplastic; few fine roots; 70 percent gravel; very strongly calcareous; moderately alkaline.

The A1 horizon is strongly calcareous to very strongly calcareous. Thickness ranges from 11 to 18 inches. The C horizon ranges from brown to light brownish gray or to brown in a hue of 10YR or 7.5YR. Texture ranges from very gravelly fine sandy loam or gravelly fine sandy loam to very gravelly loamy sand. Reaction is moderately alkaline to strongly alkaline. Gravel content ranges from 15 to 35 percent in the surface layer, from 30 to 50 percent in the subsoil, and from 50 to 80 percent in the substratum. In some areas the soil contains some cobblestones on the surface and throughout the profile.

The soil is fairly easy to till, but the gravel causes excessive wear on tillage implements. Permeability is moderately rapid. Runoff is slow, and the erosion hazard is slight. This soil holds 3.0 to 3.75 inches of available water to a depth of 5 feet. The organic-matter content of the surface layer ranges from 1 to 3.5 percent, and natural fertility is moderate. Roots are mostly in the surface layer above the very gravelly material, but some roots penetrate the very gravelly material.

Included in mapping were small areas of Millville silt loam, 2 to 4 percent slopes.

This Green Canyon soil is used for irrigated crops of alfalfa, small grain, and pasture. Where irrigation water is not available, the soil is used for dryland crops of alfalfa and winter wheat. A few acres are used for grazing. (Capability unit IVs-24, irrigated, VIs-U4, non-irrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Green Canyon gravelly loam, 0 to 3 percent slopes (GrA).—This soil occurs with Green Canyon gravelly loam, 3 to 7 percent slopes. Except for slope, it is similar to that soil. It is on the lower part of fans. Runoff is slow, and the hazard of erosion is slight.

Included in mapping were small areas of Millville silt loam, 2 to 4 percent slopes.

This Green Canyon soil is used mainly for irrigated crops of alfalfa, small grain, and pasture. A small acreage is in apple orchards. (Capability unit IVs-24,

irrigated, VIs-U4, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Greenson Series

The Greenson series consists of somewhat poorly drained and moderately well drained soils that formed in mixed lake sediment and alluvium derived dominantly from limestone, sandstone, and quartzite. These nearly level to strongly sloping soils are on low lake terraces and fans at elevations of 4,450 to 4,650 feet. Slopes range from 0 to 10 percent. The vegetation is saltgrass, foxtail, alkali sacaton, Kentucky bluegrass, and some sedges and wiregrass. Average annual precipitation is 14 to 17 inches, and mean annual air temperature is 45° to 48° F. The frost-free season is 120 to 140 days. Greenson soils are associated with Collett, Nibley, Logan, Lewiston, and Roshe Springs soils.

In a representative profile (fig. 4), the surface layer is gray, mildly alkaline loam about 16 inches thick. The

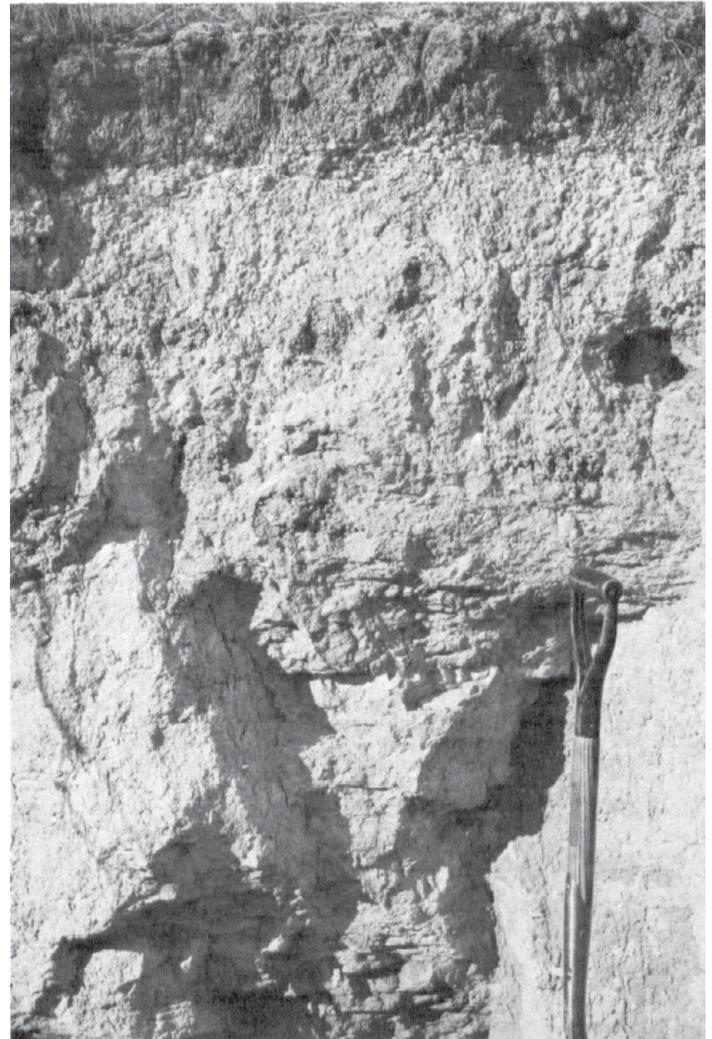


Figure 4.—Profile of Greenson loam, 0 to 3 percent slopes, showing the light-colored layer of lime accumulation that is near the surface of this soil.

subsoil is light brownish-gray, moderately alkaline loam about 7 inches thick. The substratum to a depth of 60 inches or more, is light-gray or very pale brown loam. Some carbonates have been leached from the surface layer and subsoil and redeposited in the substratum.

Greenson soils are used dominantly for irrigated crops of alfalfa, small grain, corn, sugar beets, and improved pasture. Some areas are used for range, and some are used for community and industrial development.

Greenson loam, 0 to 3 percent slopes (GsA).—This soil is on broad, smooth or slightly undulating, low lake terraces.

Representative profile in an irrigated area, 1 mile east and $\frac{1}{4}$ mile north of Wellsville Cemetery, 1,320 feet south and 600 feet east of the northeast corner of sec. 36, T. 11 N., R. 1 W.:

- Ap—0 to 7 inches, gray (10YR 5/2) loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common medium pores; slightly calcareous; mildly alkaline; clear, smooth boundary.
- A1—7 to 16 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure that parts to moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common medium pores; slightly calcareous; mildly alkaline; clear, wavy boundary.
- B2—16 to 23 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few medium pores; slightly calcareous, moderately alkaline; clear, wavy boundary.
- C1ca—23 to 39 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; few, fine, faint, yellowish-brown (10YR 5/8) moist mottles; weak, very fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; strongly calcareous; moderately alkaline; gradual, wavy boundary.
- C2ca—39 to 51 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; common, medium, distinct, strong-brown (7.5YR 5/6), moist mottles; massive; hard, friable, slightly sticky and slightly plastic; strongly calcareous; moderately alkaline; clear, wavy boundary.
- C3—51 to 72 inches, very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) when moist; common, medium, distinct, strong-brown (7.5YR 5/6), moist mottles; massive; hard, friable, slightly sticky and slightly plastic; strongly calcareous; moderately alkaline.

The A horizon ranges from gray to dark gray or dark grayish brown. Its texture is loam to silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is slightly calcareous. Thickness ranges from 12 to 19 inches. The B2 horizon ranges from light brownish gray to light gray or grayish brown in a hue of 10YR or 2.5Y. Texture is loam or silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is slightly calcareous to moderately calcareous. Thickness ranges from 4 to 13 inches. The C horizon ranges from light gray to white or pale olive in hues of 10YR or 5Y. Texture ranges generally from loam to silt loam or silty clay loam, but is gravelly loam in places. A horizon of lime accumulation occurs at a depth of 16 to 24 inches and is weakly cemented in places. Reaction is moderately alkaline to strongly alkaline. Faint to distinct, yellowish-brown or strong-brown mottles are at depths between 20 and 38 inches.

This soil is easy to till. Permeability is moderate. Runoff is slow, and the erosion hazard is none to slight. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Depth to the water table ranges from 30

to 60 inches. Much of the acreage is artificially drained. Roots extend to a depth of 5 feet where the soils are drained. In the undrained areas, most roots are above the water table.

Included in mapping were small areas of Collett silty clay loam and Logan silty clay loam.

This Greenson soil is used for irrigated crops of alfalfa, small grain, sugar beets, and pasture. (Capability unit IIw-2, irrigated; not in a range site or woodland suitability group; wildlife suitability group 1)

Greenson loam, 3 to 6 percent slopes (GsB).—This soil is similar to Greenson loam, 0 to 3 percent slopes, except that it is more sloping and its surface layer is 8 to 16 inches thick. This moderately well drained, moderately sloping soil generally is in small areas on terrace breaks. In a few places, the substratum is gravelly below a depth of 36 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in mapping were small areas of Collett silty clay loam and small areas of Greenson loam, 6 to 10 percent slopes.

This soil is used mainly for irrigated crops of alfalfa, small grain, and improved pasture. A few small areas are used for native meadow pasture. (Capability unit IIw-2, irrigated; Semiwet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Greenson loam, 6 to 10 percent slopes (GsC).—This soil commonly is in long, narrow bands on terrace breaks. It is similar to Greenson loam, 0 to 3 percent slopes, except that it is more strongly sloping and its surface layer is 8 to 12 inches thick. Wetness generally results from seeps along the upper areas of this soil. Surface runoff is medium, and the hazard of erosion is moderate.

Included in mapping were a few small areas of Nibley silty clay loam, 3 to 6 percent slopes, and a few small areas of soils that have a gravelly substratum.

This soil is used mostly for irrigated crops of alfalfa, small grain, and pasture. Some areas are used for native meadow pasture. (Capability unit IIIe-2, irrigated; Semiwet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Greenson loam, deep over gravel, 0 to 1 percent slopes (GvA).—This soil is similar to Greenson silt loam, 0 to 3 percent slopes, except that the substratum is gravelly. Depth to gravelly loam material is below 36 inches. In places small amounts of gravel are scattered on the surface and throughout the profile. In an area of this soil south of the old Logan Sugar Factory, the gravel is strongly cemented at a depth below 3 feet. This makes drainage difficult and more costly. Runoff is slow, and the hazard of erosion is none to slight.

Included in mapping were small areas of Provo gravelly loam.

This Greenson soil is used mainly for irrigated crops of alfalfa, small grain, sugar beets, corn, and improved pasture. Small areas are used for native meadow hay and pasture. (Capability unit IIw-2, irrigated; Semiwet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Greenson loam, deep over clay, 0 to 1 percent slopes (GuA).—This soil is similar to Greenson loam, 0 to 3 percent slopes, except that the substratum is silty clay or heavy silty clay loam that is slowly permeable. The soil is on

low lake terraces adjacent to Collett, Logan, and Nibley soils. An area of this soil in the vicinity of the Utah State University Drainage and Reclamation Farm is moderately saline and alkali affected. This soil is somewhat poorly drained, and its permeability is slow, Runoff is slow, and the hazard of erosion is slight. Depth to the fine-textured underlying material ranges from 32 to 40 inches. The water table commonly is above the fine-textured material.

This soil is mostly used for irrigated crops of alfalfa, small grain, corn, sugar beets, and pasture. (Capability unit IIIw-25, irrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Hendricks Series

The Hendricks series consists of well-drained soils that formed in noncalcareous alluvium derived from sandstone and quartzite. These soils are on old alluvial fans, slightly below or just above the highest lake terraces at elevations of 4,800 to 5,400 feet. Slopes range from 1 to 20 percent. The vegetation is big sagebrush, slender wheatgrass, cheatgrass, prairie junegrass, balsamroot, and yarrow. The average annual precipitation is 17 to 20 inches, the mean annual air temperature is 44° to 48° F., and the frost-free season is 120 to 140 days. Hendricks soils are associated with Nebeker, Hiibner, and Crowshaw soils.

In a representative profile, the surface layer is dark grayish-brown, neutral silt loam about 5 inches thick. The upper part of the subsoil is dark grayish-brown silt loam about 10 inches thick, and the lower part is brown to dark-brown or yellowish-brown, slightly acid silty clay loam to a depth of 60 inches or more.

Hendricks soils generally are used chiefly for dry cropland, but some areas are irrigated. Crops are small grain, alfalfa, silage corn, sugar beets, and pasture. Some small areas are used for range.

Hendricks silt loam, 6 to 10 percent slopes (HdC).—This soil is on gently undulating, old alluvial fans on or above the highest lake terraces. The soil extends along both eastern and western sides of Cache Valley.

Representative profile in a cultivated area, 1 mile south and 1¾ miles east of the old North Cache High School at Richmond, 900 feet east and 50 feet south of the northwest corner of the southeast quarter of sec. 1, T. 13 N., R. 1 E.:

- Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; very dark brown (10YR 2/2) when moist; moderate, medium, granular structure that parts to moderate, fine, granular structure; slightly hard, friable, slightly sticky and plastic; common fine roots; common fine pores; neutral; abrupt, smooth boundary.
- B1—5 to 15 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; common fine and medium pores and few large pores; slightly acid; clear, smooth boundary.
- B21t—15 to 27 inches, brown to dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine pores and few medium pores; thin continuous clay films; slightly acid; clear, wavy boundary.

B22t—27 to 47 inches, yellowish-brown (10YR 5/4) silty clay loam, brown to dark brown (7.5YR 4/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many fine pores; thin continuous clay films; slightly acid; clear, smooth boundary.

B23t—48 to 66 inches, brown (7.5YR 5/4) silty clay loam, brown to dark brown (7.5YR 4/3) when moist; weak, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine pores and few medium pores; common thin clay films; slightly acid.

The A horizon ranges from dark grayish brown to grayish brown or to very dark grayish brown in a hue of 10YR. Texture ranges from silt loam or loam to very fine sandy loam. Thickness ranges from 5 to 12 inches. Some areas have a small amount of gravel and a few cobblestones scattered on the surface and throughout the profile. The B2t horizon ranges from silty clay loam to clay loam. Reaction is neutral to slightly acid.

The soil is easy to till. Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots extend to a depth of 5 feet or more.

Included in mapping were small areas of Crowshaw gravelly loam, 6 to 10 percent slopes, and small areas of recent stony alluvium.

This soil is used mainly for dryland crops of alfalfa and small grain. Some areas are irrigated. (Capability unit IIIe-2, irrigated, IIIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Hendricks silt loam, 1 to 3 percent slopes (HdA).—This soil is on the lower part of alluvial fans. Except for slope, it is similar to Hendricks silt loam, 6 to 10 percent slopes. Runoff is slow, and the hazard of erosion is slight.

Included in mapping were small areas of Ricks gravelly loam, 0 to 3 percent slopes, and a few small areas of a soil that has slopes of 3 to 6 percent.

About 60 percent of the acreage of this Hendricks soil is irrigated. Crops are alfalfa, small grain, corn for silage, and sugar beets. Nearly 40 percent is used for dryland crops of alfalfa and small grain. A few areas are used for range. (Capability unit IIc-2, irrigated, IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Hendricks silt loam, 3 to 6 percent slopes (HdB).—This is a gently undulating soil on old alluvial fans. It is similar to Hendricks silt loam, 6 to 10 percent slopes, except that it is less sloping and its surface layer is about 7 inches thick. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is easy to work, has good tilth, and can be cultivated within a wide range of moisture content.

Included in mapping were small areas of Ricks gravelly loam, 3 to 6 percent slopes.

About 70 percent of the acreage of this Hendricks soil is irrigated, and 30 percent is dryfarmed. Alfalfa and small grain are the principal crops. (Capability unit IIe-2, irrigated; IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Hendricks silt loam, 10 to 20 percent slopes (HdD).—This soil is on alluvial fans with other Hendricks soils. Except for slope, it is similar to Hendricks silt loam, 6

to 10 percent slopes. The subsoil ranges from silty clay loam to heavy silt loam in the upper part and is silty loam in the lower part. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Included in mapping were small areas of Sterling gravelly loam, 10 to 20 percent slopes, and a few small areas of a soil that has slopes of slightly more than 20 percent.

This Hendricks soil is used mostly for dryland crops of small grain and alfalfa. Some areas are used for range. (Capability unit IVE-2, irrigated, IVE-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hiibner Series

The Hiibner series consists of well-drained soils that formed in colluvium and alluvium derived from sandstone and quartzite. These soils are on alluvial fans and on dissected slopes of mountains. The elevation ranges from 4,500 to 6,000 feet, and slopes range from 1 to 30 percent. The average annual precipitation is 17 to 20 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 100 to 140 days. Hiibner soils are associated with Nebeker, Parleys, Hendricks, and Crowshaw soils.

In a representative profile, the surface layer is very dark grayish-brown and dark grayish-brown, neutral extremely stony gravelly clay loam about 6 inches thick. The subsoil is reddish-brown, slightly acid very cobbly clay that extends to a depth of 60 inches or more.

Hiibner soils are used chiefly for range. Some small areas are used for dryland crops of alfalfa and small grain.

Hiibner extremely stony clay loam, 1 to 30 percent slopes (HeE).—This soil is on alluvial fans and mountain foot slopes, mainly near the town of Mendon and east of Paradise.

Representative profile, about 1 mile west of Mendon, 30 feet west and 20 feet north of the northeast corner of sec. 1, T. 11 N., R. 2 W.:

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) extremely stony clay loam, very dark brown (10YR 2/2) when moist; weak, fine, platy structure that parts to weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; medium fine pores; about 25 percent gravel and cobblestones and 5 percent stones; neutral; clear, wavy boundary.

A12—3 to 6 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine roots and few medium roots; many fine and large pores; about 25 percent gravel and cobblestones and 5 percent stones; neutral; clear, wavy boundary.

B21t—6 to 12 inches, brown to dark-brown (7.5YR 4/2) very cobbly clay, dark brown (7.5YR 3/2) when moist; strong, medium, prismatic structure that parts to moderate, fine, angular blocky structure; extremely hard, extremely firm, sticky and plastic; common medium roots; common fine and medium pores; 40 percent gravel and cobblestones and 10 percent stones; common moderately thick clay films; slightly acid; gradual, wavy boundary.

B22t—12 to 27 inches, reddish-brown (5YR 5/4) very cobbly clay, reddish brown (5YR 4/4) when moist; strong, coarse, prismatic structure that breaks to moderate, fine, angular blocky structure; extremely hard, ex-

tremely firm, very sticky and very plastic; common fine and medium roots; common fine pores; common thick clay films; 50 percent cobblestones and gravel and 10 percent stones; slightly acid; gradual, wavy boundary.

B23t—27 to 60 inches, reddish-brown (5YR 5/4) very cobbly clay, reddish brown (5YR 4/4) when moist; strong, coarse, prismatic structure that breaks to moderate, fine, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine and medium roots; few fine and medium pores; common thick clay films; 70 percent cobblestones and gravel and 10 percent stones; slightly acid.

The A1 horizon ranges from very dark grayish brown to dark grayish brown or to brown in a hue of 10YR or 7.5YR. Texture ranges from gravelly loam to gravelly clay loam or extremely stony clay loam. Reaction is neutral to slightly acid. Thickness ranges from 5 to 12 inches. The B2t horizon ranges from reddish brown to brown or dark brown to yellowish brown in hues of 10YR to 5YR. Texture ranges from very cobbly clay to extremely stony heavy clay loam. The B2t horizon is 40 to 70 percent gravel and cobblestones and about 10 percent stones. Reaction ranges from slightly acid to mildly alkaline.

Permeability is slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 5 to 7 inches of available water to a depth of 5 feet. Roots extend to a depth of 4 feet or more.

Included in mapping were small areas of Nebeker silt loam, 10 to 25 percent slopes, and small areas of Hiibner gravelly clay loam, 20 to 30 percent slopes.

This soil is used for range that is grazed after crops are harvested from adjacent fields. (Capability unit VIIs-MX5, nonirrigated; Mountain Stony Clay range site; not in a woodland suitability group; wildlife suitability group 3)

Hiibner gravelly clay loam, 3 to 10 percent slopes (HeC).—This soil is on mountain foot slopes and high terraces. It is similar to Hiibner extremely stony clay loam, 1 to 30 percent slopes, except that the surface layer is gravelly clay loam 8 to 12 inches thick and is slightly eroded. Runoff is slow to medium, and the erosion hazard is slight to moderate.

Included in mapping were small areas of a soil that has 1 to 3 percent slopes, and small areas of Nebeker silt loam, 6 to 10 percent slopes.

This Hiibner soil is used mainly for range that is grazed after the crops from adjacent cropland have been harvested. Some areas are used for dryland small grain crops. (Capability unit IIIe-MX5, nonirrigated; Mountain Stony Clay range site; not in a woodland suitability group; wildlife suitability group 3)

Hiibner gravelly clay loam, 10 to 20 percent slopes (HeD).—This soil is in long, narrow tracts on mountain foot slopes and high lake terrace escarpments. It is similar to Hiibner extremely stony clay loam, 1 to 30 percent slopes, except that the surface layer is gravelly clay loam 9 to 12 inches thick and is slightly eroded. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Nebeker silt loam, 10 to 25 percent slopes, and small areas of a soil that has slightly steeper slopes.

This Hiibner soil is used for range that is grazed after the crops on adjacent cropland areas have been harvested. (Capability unit IVE-MX5, nonirrigated; Mountain Stony Clay range site; not in a woodland suitability group; wildlife suitability group 3)

Hiibner gravelly clay loam, 20 to 30 percent slopes (HeE).—This soil is in long, narrow tracts on mountain foot slopes and high lake terrace escarpments. It is similar to Hiibner extremely stony clay loam, 1 to 30 percent slopes, except that the surface layer is gravelly clay loam 7 to 12 inches thick and is slightly eroded. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Included in mapping were small areas of Nebeker silt loam, 10 to 25 percent slopes, and small areas of a soil that has slightly steeper slopes.

This Hiibner soil is used for rangeland, watershed, and wildlife habitat. (Capability unit VIe-MX5, nonirrigated; Mountain Stony Clay range site; not in a woodland suitability group; wildlife suitability group 3)

Hillfield Series

The Hillfield series consists of well-drained soils that formed in mixed lake sediment derived mainly from limestone, sandstone, and quartzite. These soils are on terrace escarpments and rolling terraces along the eastern side of Cache Valley. The elevation ranges from 4,800 to 5,100 feet. Slopes range from 10 to 30 percent. The vegetation is western wheatgrass, cheatgrass, bluebunch wheatgrass, yarrow, and big sagebrush. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 46° to 49° F., and the frost-free season is 130 to 150 days. Hillfield soils are associated with Parleys, Timpanogos, McMurdie, and Ricks soils.

In a representative profile, the surface layer is brown, mildly alkaline silt loam about 8 inches thick. This is underlain by mildly alkaline, light yellowish-brown silt loam, very pale brown and light yellowish-brown loam, and light yellowish-brown very fine sandy loam that extends to a depth of 60 inches or more. The soil is strongly calcareous throughout. Some carbonates have leached from the upper part of the soil and redeposited. at a depth of 7 to 12 inches, to form a lime horizon.

Hillfield soils are used mostly for dryland crops of alfalfa and small grain.

Hillfield silt loam, 20 to 30 percent slopes, eroded (HgE2).—This soil is on high lake terrace escarpments along the eastern side of Cache Valley. It is rolling or hilly and has short slopes that generally face west. The soil is moderately eroded.

Representative profile in a cultivated area, 2 miles north and ½ mile east of Paradise, 400 feet south and 600 feet east of the northeast corner of the southeast quarter of sec. 15, R. 10 N., R. 1 E.:

Ap—0 to 8 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; soft, friable, slightly sticky and slightly plastic; common fine roots and few medium roots; common fine pores; strongly calcareous, mildly alkaline; abrupt, smooth boundary.

C1ca—8 to 15 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; weak, medium, subangular blocky structure that parts to moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots and few medium roots; common fine pores and few medium pores; strongly calcareous; mildly alkaline; clear, smooth boundary.

C2ca—15 to 23 inches, very pale brown (10YR 7/4) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; slightly hard, very friable,

slightly sticky and slightly plastic; few fine roots; common fine pores; strongly calcareous; mildly alkaline; clear, wavy boundary.

C3—23 to 40 inches, light yellowish-brown (10YR 6/4) loam, brown (10YR 5/3) when moist; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine and few medium pores; strongly calcareous; mildly alkaline.

C4—40 to 60 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, brown (10YR 5/3) when moist; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; single grain; soft, very friable, nonsticky and nonplastic; strongly calcareous; mildly alkaline.

The A horizon ranges from brown to pale brown or grayish brown. Thickness ranges from 7 to 9 inches. Texture is dominantly silt loam but ranges to loam, very fine sandy loam, or light silty clay loam. The Cca and C horizons range from very pale brown to light yellowish brown or light brownish gray. These horizons are stratified and range from loamy to loamy fine sand or to silty clay loam. The calcium carbonate equivalent in the Cca horizon ranges from 20 to 40 percent. Reaction is mildly alkaline to moderately alkaline.

This soil is easy to till. Permeability is moderate. Runoff is medium to rapid, and the hazard of erosion is moderate to high. This soil holds 8 to 10 inches of available water to a depth of 5 feet. Roots extend to a depth of 4 feet or more.

Included in mapping were small areas of Parleys silt loam, 6 to 10 percent slopes, and a few small areas of a Hillfield soil that has slopes of 10 to 20 percent.

This soil is used mostly for range but provides only limited grazing. Some of the acreage is used for dryland crops of alfalfa and small grain. (Capability unit VIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Hillfield-Timpanogos silt loams, 10 to 30 percent slopes, eroded (HhE2).—This complex consists of rolling to moderately steep soils on high lake terraces on the eastern side of Cache Valley. Runoff is medium to rapid, and the hazard of erosion is moderate to high. About 60 percent of the association is Hillfield silt loam, 20 to 30 percent slopes, eroded, and about 40 percent is Timpanogos silt loam, 10 to 20 percent slopes, eroded.

The Hillfield soil is steeper than the Timpanogos soil and has slopes that face south and west. In places its surface layer is very fine sandy loam.

The more gently sloping Timpanogos soil has a northerly exposure. It is similar to Timpanogos silt loam, 0 to 3 percent slopes, except that it is more sloping and its surface layer is 7 to 9 inches thick. The soil is moderately eroded, and in places the subsoil has been exposed by tillage.

Included in mapping were small areas of Parleys silt loam, 6 to 10 percent slopes.

The soils of this complex are used for dryfarming and interspersed areas of range. Winter wheat and alfalfa are the principal crops. (Capability unit VIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Hoskin Series

The Hoskin series consists of somewhat excessively drained soils that formed in residuum and colluvium derived from the Wasatch conglomerate and sandstone. Bedrock is at a depth of 24 to 40 inches. These soils are

on dominantly south- and west-facing mountain slopes at elevations of 6,000 to 8,000 feet. Slopes range from 1 to 70 percent. The vegetation is big sagebrush, bluebunch wheatgrass, Great Basin wildrye, bitterbrush, yellowbrush, cheatgrass, serviceberry, and balsamroot. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 40° to 45° F., and the frost-free season is 70 to 90 days. Hoskin soils are associated with Ant Flat, Scave, Lucky Star, Agassiz, and Scout soils.

In a representative profile, the surface soil is brown to dark-brown, neutral cobbly loam about 7 inches thick. The subsoil is brown, neutral very cobbly loam about 9 inches thick. The substratum is brown, neutral very cobbly loam about 12 inches thick. Bedrock is at a depth of about 28 inches. Between the depths of 7 and 20 inches, the soil is continuously dry for a period of 50 days or more in summer.

Hoskin soils are used for range, wildlife habitat, and watershed.

Hoskin cobbly loam, 30 to 70 percent slopes, eroded (HKG2).—This soil is on west- and south-facing slopes of mountains. It is mostly in the area south of Hardware Ranch near the Sheep Creek and Mill Creek drainages. Small areas are in the Cinnamon Creek area south of Mineral Point. Other areas are scattered throughout the mountains.

Representative profile, 100 feet west and 100 feet south of the northeast corner of sec. 21, T. 9 N., R. 3 E., 6½ miles south and 1 mile west of Hardware Ranch :

A1—0 to 7 inches, brown to dark-brown (7.5YR 4/3) cobbly loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; soft, friable, nonsticky and slightly plastic; many fine, medium, and large roots; 40 percent gravel and cobblestones; neutral; clear, wavy boundary.

B2t—7 to 16 inches, brown (7.5YR 5/4) very cobbly loam, dark brown (7.5YR 3/4) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; many fine and medium roots; many fine pores; common thin clay films; 60 percent gravel and cobblestones; neutral; gradual, wavy boundary.

C—16 to 28 inches, brown (7.5YR 5/4) very cobbly loam; brown to reddish brown (5YR 4/4) when moist; massive; soft, friable, nonsticky and slightly plastic; few fine and medium roots; many fine pores; soil matrix is noncalcareous, lime on underside of coarse fragments; 80 percent cobblestones and stones; neutral.

R—28 inches, consolidated conglomerate.

The combined thickness of the A1, B1, and B2t horizons ranges from 14 to 30 inches. Coarse fragments are mainly cobblestones and gravel-size, rounded or slightly angular fragments of quartzite or sandstone. Their content ranges from 20 to 50 percent in the A1 and B1 horizons and from 50 to 80 percent in the B2t and C horizons. The A1 horizon ranges from brown to dark brown or reddish brown in a hue of 7.5YR or 5YR. Reaction is neutral to slightly acid. Thickness ranges from 5 to 12 inches. In the Cinnamon Creek area, this soil is only slightly eroded and the surface layer ranges from 12 to 15 inches in thickness. The B2t horizon ranges from brown to reddish brown or strong brown in a hue of 7.5YR or 5YR. Texture ranges from very cobbly sandy clay loam to very cobbly loam. Reaction ranges from neutral to medium acid. Thickness ranges from 8 to 15 inches. The C horizon ranges from brown or reddish brown to yellowish brown or light reddish brown in a hue of 7.5 YR, 5YR, or 10YR. Texture ranges from very cobbly loam or stony loam to very cobbly sandy loam. Reaction is neutral to mildly alkaline.

Permeability is moderately rapid. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. This soil holds 3.5 to 4.0 inches of available water above the bedrock. Roots penetrate to the bedrock.

Included in mapping were small areas of Sheep Creek cobbly loam, 30 to 70 percent slopes, eroded.

This Hoskin soil is used for range, wildlife habitat, and watershed. (Capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hoskin-Datwyler association, eroded (30 to 70 percent slopes) (HKG2).—This mapping unit consists of soils on Murrays Hill at the south end of the Wellsville Mountain. These soils generally are on the broad ridges and upper side slopes adjacent to the ridges, which have south and east aspects. They are at elevations of 5,500 to 6,500 feet. About 50 percent of the association is Hoskin cobbly loam, 30 to 70 percent slopes, eroded; 30 percent Datwyler cobbly silty clay loam, 30 to 60 percent slopes; and 20 percent included soils.

The Hoskin soil is dominant on the landscape and is intermingled with outcrops of limestone and limy sandstone, as well as ledges and talus slopes. This soil is similar to Hoskin cobbly loam, 30 to 70 percent slopes, eroded. It has a cover of grasses and shrubs.

The Datwyler soil has open, south-facing slopes and is in slightly more concave positions than the Hoskin soil. It is similar to Datwyler cobbly silty clay loam, 30 to 60 percent slopes, which is described under the Datwyler series.

Included in mapping were areas of rock outcrop, areas of Smarts gravelly silt loam, 30 to 70 percent slopes, and areas of Elzinga silt loam, 30 to 60 percent slopes. The Smarts and Elzinga soils are on the lower slopes and in depressions, and the vegetation is maple. The rock outcrop makes up 10 percent of the total acreage in the association, and Smarts and Elzinga soils each make up 5 percent.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hoskin-Elzinga association, eroded (30 to 70 percent slopes) (HMG2).—This mapping unit consists of soils on slopes of mountains south of Mineral Point. The landscape is characterized by parallel ridges of varying parent rock. About 40 percent of the association is Hoskin cobbly loam, 30 to 70 percent slopes, eroded; 35 percent is Elzinga silt loam, 30 to 60 percent slopes; 20 percent is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded; and about 5 percent is included soils.

The Hoskin and Agassiz soils are on the slightly convex ridgetops and side slopes that have south and west aspects. The vegetation is mostly big sagebrush, bunchgrasses, and forbs on the Hoskin soil and mountain-mahogany, snowberry, bitterbrush, and ceanothus on the Agassiz soil.

The Elzinga soil has slightly concave, mainly north-facing slopes. The vegetation is maple and a sparse understory of chokecherry, wheatgrass, and false Solomons-seal.

Included in mapping were areas of Yeates Hollow extremely rocky silt loam, 30 to 70 percent slopes.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Hoskin soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3. Elzinga soil is in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site; not in a woodland suitability group; wildlife suitability group 3. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hoskin-Scave association (6 to 70 percent slopes) (HNG).—This mapping unit consists of soils that are mainly south of Hardware Ranch in the Mill Creek area. These soils are on slopes of mountains. About 50 percent of the association is Hoskin cobbly loam, 30 to 70 percent slopes, eroded; 30 percent is Scave silt loam, 10 to 30 percent slopes; and 20 percent is Ant Flat loam, 6 to 20 percent slopes.

The Hoskin soil has south-facing slopes, where the vegetation is perennial grasses and shrubs. The Scave soil has north-facing slopes, where the vegetation is aspen. The Ant Flat soil is on broad ridgetops and at the heads of draws, where the vegetation is perennial grasses and shrubs.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Hoskin soil is capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3. Scave soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4. Ant Flat soil is in capability unit VIe-M, non-irrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hoskin-Scout association, eroded (30 to 70 percent slopes) (HOG2).—This mapping unit consists of steep and very steep soils on James Peak in the southern part of Cache County. About 60 percent of the association is Hoskin cobbly loam, 30 to 70 percent slopes, eroded; 25 percent is Scout gravelly loam, 40 to 70 percent slopes; 5 percent is rubble land and rock outcrop; and 10 percent is minor soils.

The Hoskin soil has open slopes that face west, south, and east. This soil is similar to Hoskin cobbly loam, 30 to 70 percent slopes, except that its slopes are dominantly 30 to 60 percent. Its plant cover is big sagebrush and bunchgrasses. The Scout soil has slopes that mostly face north. It is similar to Scout gravelly loam, 40 to 70 percent slopes, except that 1 to 2 percent of its surface is covered with scattered stones. Its plant cover is Douglas-fir and alpine fir. Rock outcrop and rubble land are near the mountain, and they support little vegetation.

Included in mapping were areas of Yeates Hollow soil at the mouths of small canyons on alluvial fans.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. Trees have been harvested from areas of the Scout soil. (Hoskin soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3. Scout soil is in capability unit VIIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4r1; wildlife suitability group 4)

Hoskin-Smarts association, eroded (30 to 70 percent slopes) (HSG2).—This mapping unit is on the lower east side and upper west side of Wellsville Mountain. About 60 percent of it is Hoskin cobbly loam, 30 to 70 percent slopes, eroded; 25 percent is Smarts gravelly silt loam, 30 to 70 percent slopes; and 15 percent is rock outcrop and rock land.

The Hoskin soil is on the lower slopes of uniformly steep, somewhat dissected, south- and west-facing dip scarp slopes. It is similar to Hoskin cobbly loam, 30 to 70 percent slopes, except that its slopes are dominantly 60 to 70 percent and its surface layer is cobbly loam to gravelly loam.

The Smarts soil is in steep drainageways and near the bottom of slopes. It is similar to Smarts silt loam, 10 to 30 percent slopes, except that it is steeper and its surface layer is 20 to 30 percent gravel and is 15 to 25 inches thick.

Rock outcrop and rock land are in the form of ledges and rockslides on talus slopes.

Soils of this mapping unit are used for watershed and wildlife habitat. (Hoskin soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site. Smarts soil is in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site. Neither soil is in a woodland suitability group; both are in wildlife suitability group 3)

Hoskin gravelly loam, thick surface, 1 to 6 percent slopes (HIB).—This soil is on the alluvial valley bottom of Strawberry Valley and in small areas adjacent to streams. It is somewhat less gravelly and cobbly in the subsoil than other Hoskin soils, and it has more gentle slopes.

This soil is moderately well drained, and its permeability is moderate. Runoff is slow, and the erosion hazard is slight. This soil holds 5.0 to 7.0 inches of available water to a depth of 5 feet. The water table is between depths of 40 and 60 inches late in spring and early in summer for 30 to 60 days following snowmelt. Roots penetrate to a depth of 4 feet or more but are mostly above the very gravelly material.

This soil is used for range and wildlife habitat. (Capability unit VIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Hyrum Series

The Hyrum series consists of well-drained, very cobbly soils. These soils formed in alluvium and modified lake sediment derived mainly from sandstone and quartzite and, to a lesser extent, from limestone rocks. They are on high and intermediate lake terraces at elevations of 4,600 to 5,000 feet. Slopes range from 4 to 25 percent. The vegetation is big sagebrush, slender wheatgrass, western wheatgrass, and bluebunch wheatgrass. The average annual precipitation ranges from 15 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 130 to 150 days. Hyrum soils are associated with Crowshaw, Hendricks, Hiibner, Nebeker, Mendon, and Ricks soils.

In representative profile, the surface layer is very dark grayish-brown, neutral gravelly loam about 8 inches thick. The subsoil is very dark grayish brown, dark grayish-

brown, and grayish-brown, neutral very cobbly clay loam about 36 inches thick. The substratum is pale-brown, mildly alkaline very cobbly loam to a depth of 60 inches or more.

Hyrum soils are used for dryfarmed crops and for range.

Hyrum gravelly loam, 10 to 25 percent slopes (HuE).—

This soil is on intermediate and high terraces, chiefly in an area west and south of the town of Mendon. Slopes are generally short and undulating.

Representative profile, one-half mile west of Mendon, 400 feet south and 900 feet west of the northeast corner of sec. 7, T. 11 N., R. 1 W.:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; hard, friable, slightly sticky and plastic; many fine roots; many fine pores; neutral; clear, smooth boundary.

B1—8 to 17 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, granular structure; hard, friable, sticky and plastic; few thin clay films; common fine roots; many fine, medium, and large pores; neutral; diffuse, smooth boundary.

B2t—17 to 31 inches, dark grayish-brown (10YR 4/2) very cobbly clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; many fine and medium pores; thin continuous clay films on peds; neutral; clear, smooth boundary.

B22t—31 to 42 inches, grayish-brown (10YR 5/2) very cobbly clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few fine roots; many medium and fine pores; few thin clay films on some peds; neutral.

C—42 to 60 inches, pale-brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline.

The combined thickness of the A and B horizons ranges from 30 to 45 inches. Coarse fragments are mostly cobblestone- and gravel-sized, slightly rounded and angular fragments of sandstone and quartzite rock but include fragments of limestone in places. The amount of coarse fragments ranges from 20 to 40 percent, by volume, in the A1 horizon and from 50 to 80 percent in the B and C horizons. The A1 horizon ranges from very dark grayish brown to grayish brown. Thickness ranges from 7 to 8 inches. The B2t horizon ranges from dark grayish-brown to brown. Texture ranges from very cobbly clay loam to very cobbly heavy loam. The C horizon ranges from pale brown to brown or light grayish brown. Texture ranges from very cobbly loam to very cobbly heavy very fine sandy loam. Reaction is mildly alkaline to neutral. In places, calcareous lake sediments are present at depths below 36 inches.

This soil is somewhat difficult to till. Permeability is moderate. Runoff is medium, and the erosion hazard is moderate. This soil holds 5 to 7 inches of water to a depth of 5 feet. Roots penetrate to a depth of 4 feet or more.

Included in mapping were small areas of Crowshaw gravelly loam, 3 to 6 percent slopes.

This soil is used mostly for dryfarmed crops of alfalfa or alfalfa and grass mixtures and winter wheat. Some areas are used for range. (Capability unit IVE-UX, nonirrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Hyrum gravelly loam, 4 to 8 percent slopes (HuC).—
This soil is mostly on medium lake terraces at the south

end of Newton Hill. It is similar to Hyrum gravelly loam, 10 to 25 percent slopes, except that it is less sloping and its surface layer is 8 to 10 inches thick. Runoff is slow, and the hazard of erosion is slight.

Included in mapping were small areas of soils that have a cobbly surface layer and small areas of Hendricks silt loam, 3 to 6 percent slopes.

This Hyrum soil is used for dryfarmed crops of winter wheat and alfalfa. (Capability unit IIIe-UX, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Hyrum cobbly loam, 4 to 8 percent slopes (HyC).—

This soil is mainly in an area about a mile northeast of Newton. It is similar to Hyrum gravelly loam, 10 to 25 percent slopes, except that it is less sloping and its surface layer is about 30 percent cobblestones. The cobblestones are mostly semirounded quartzite. Runoff is slow, and the erosion hazard is slight.

Included in mapping were small areas of shallow gravelly soils.

This Hyrum soil is used mostly for dryfarmed crops of wheat. In places some of the larger cobblestones have been removed from the surface. (Capability unit IIIe-UX, nonirrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Jordan Series

The Jordan series consists of somewhat poorly drained soils that are affected by salt and alkali. These soils formed in mixed lake sediment derived mainly from limestone, sandstone, and shale. They are on low lake terraces near the valley bottom at elevations of 4,400 to 4,500 feet. Slopes are 0 to 1 percent. The vegetation is saltgrass, alkali sacaton, foxtail, peppergrass, and greasewood. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Jordan soils are associated with Lasil, Airport, Payson, Trenton, and Quinney soils.

In a representative profile, the surface layer is light brownish-gray, moderately alkaline silty clay loam about 5 inches thick. The subsoil is brown and pale-brown, moderately alkaline and strongly alkaline silty clay about 16 inches thick. The substratum is pinkish-gray to very pale-brown silty clay or silty clay loam to a depth of 60 inches or more.

Jordan soils are used mostly for range.

Jordan-Lasil silty clay loams (Jr).—This complex consists of soils on low lake terraces, mostly about 4 miles west of Smithfield. About 60 percent of the complex is Jordan silty clay loam, and 40 percent is Lasil silty clay loam. These soils are in areas made up of depressions and mounds. The Jordan soil is in the depressions, and the Lasil soil is on mounds that are 1 to 2 feet higher in elevation.

The Lasil soil is described under the Lasil series.

Representative profile of Jordan silty clay loam, in an area of Jordan-Lasil complex, ½ mile north and ¾ mile west of Amalga Church, 800 feet south and 1,300 feet east of the northwest corner of sec. 24, T. 13 N., R. 1 W.:

- Ap—0 to 5 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish-brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure mixed with weak, fine and medium, granular structure; hard, friable, sticky and plastic; common fine roots; common fine pores; slightly calcareous; moderately alkaline; abrupt, smooth boundary.
- B2t—5 to 10 inches, brown (7.5YR 5/2) silty clay, dark brown to brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure that parts to moderate, fine, angular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; many fine pores; thin continuous clay films; moderately calcareous; moderately alkaline; clear, wavy boundary.
- B2t_{casa}—10 to 21 inches, pale-brown (10YR 6/3) silty clay, brown (7.5YR 5/4) when moist; moderate, coarse, prismatic structure breaking to moderate, coarse, subangular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; many fine pores; thin continuous clay films; strongly calcareous; strongly alkaline; clear, smooth boundary.
- C1—21 to 42 inches, very pale brown (10YR 7/3) silty clay loam, brown (7.5YR 5/3) when moist; common, medium, distinct, yellowish-red (5YR 5/6) mottles; massive; very hard, very firm, very sticky and very plastic; common fine pores; strongly calcareous; strongly alkaline.
- C2—42 to 60 inches, pinkish-gray (7.5YR 7/2) silty clay, brown (7.5YR 5/3) when moist; common, medium, distinct, yellowish-red (5YR 5/6) mottles; massive; very hard, very firm, very sticky and very plastic; common fine pores; strongly calcareous; strongly alkaline.

The A horizon ranges from pale brown to light brownish gray in hues of 10YR and 7.5YR. The B2t horizon ranges from brown to light brown. Texture is dominantly silty clay but ranges to heavy silty clay loam. The outside of peds is noncalcareous, but peds are moderately or strongly calcareous when crushed. A horizon of carbonate accumulation begins in the lower part of the B horizon and extends into the C horizon in places. Calcium carbonate equivalent in the ca horizon ranges from 15 to 35 percent.

The C horizon ranges from very pale brown to brown in hues of 7.5YR and 10YR. The exchangeable sodium percentage ranges from 13 to 26 in the A horizon, from 30 to 90 in the B2t horizon, and from 45 to 80 in the C horizon. The soluble salt content ranges from 0.2 to 2.2 percent, and the highest concentration generally is in the lower part of the B2t horizon. Common, distinct mottles are at depths of 20 to 36 inches. The water table varies with the season, but it generally is at depths between 30 and 48 inches.

Permeability is slow to very slow. Runoff is slow, and the hazard of erosion is none to slight. This soil holds 7.5 to 9.0 inches of water to a depth of 5 feet, and only about 2 inches is available to plants because of the salt. Most roots are in the surface layer 10 to 13 inches above the strong concentrations of alkali and salt.

Included in mapping were small areas of Cache silty clay.

Soils of this mapping unit are used chiefly for range. (Capability unit VIIw-285, nonirrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Jordan silty clay loam (Jo).—This soil is on the broad, slightly concave, low lake terraces in the central part of Cache Valley.

Included in mapping were small areas of soils that have a silt loam surface layer and small areas of soils that have slopes of 1 to 3 percent. Also included were a few small areas of Cache silty clay.

This Jordan soil is mostly used for range. It is better suited to that purpose than to use for crops that require cultivation, but some small areas are cultivated. (Capa-

bility unit VIIw-285, nonirrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Kidman Series

The Kidman series consists of moderately well drained and well drained soils that formed in mixed lake sediment derived mainly from limestone and sandstone. These soils are on smooth to slightly undulating, medium lake terraces at elevations of 4,450 to 4,550 feet. Slopes range from 0 to 15 percent. The vegetation consists of big sagebrush, bluebunch wheatgrass, cheatgrass, and gumweed. The average annual precipitation ranges from 15 to 17 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 130 to 150 days. Kidman soils are associated with Lewiston, Timpanogos, and Layton soils.

In a representative profile, the surface layer is brown, mildly alkaline fine sandy loam about 8 inches thick. The subsoil is brown, mildly alkaline fine sandy loam about 12 inches thick. The substratum, to a depth of 60 inches or more, is brown and pale-brown moderately alkaline fine sandy loam and sand.

Kidman soils are used for irrigated crops.

Kidman fine sandy loam, deep water table, 0 to 2 percent slopes (KfA).—This soil is on lake terraces at medium elevations in the central part of Cache Valley.

Representative profile in a cultivated area, 3 miles west and 1¾ miles south of Lewiston, 1,200 feet north and 200 feet east of the southwest corner of sec. 13, T. 14 N., R. 1 W.:

- Ap—0 to 8 inches, brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure and weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots and few large roots; few large pores; noncalcareous; mildly alkaline; abrupt, smooth boundary.
- B1—8 to 12 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine and medium roots and few large roots; few fine, medium, and large pores; noncalcareous; mildly alkaline; clear, smooth boundary.
- B2—12 to 20 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and medium roots; common fine and medium pores; few thin clay films; noncalcareous; mildly alkaline; gradual, wavy boundary.
- C1—20 to 27 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots and few medium roots; common fine pores; noncalcareous; mildly alkaline; clear, wavy boundary.
- C2_{ca}—27 to 43 inches, brown (7.5YR 5/4) fine sandy loam, dry and moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; few fine pores; moderately calcareous; moderately alkaline; clear, wavy boundary.
- IIC3—43 to 60 inches, pale-brown (10YR 6/3) fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose, nonsticky and nonplastic; few fine roots; moderately calcareous; moderately alkaline.

The A horizon ranges from brown to dark brown or dark grayish brown. Texture ranges from fine sandy loam to very

fine sandy loam or light loam. Reaction is mildly alkaline to neutral. Thickness ranges from 8 to 20 inches. The B2 horizon ranges from brown to pale brown or light brown. Texture ranges from fine sandy loam to light loam. The Cca and C horizons range from brown or pale brown to very pale brown or light yellowish brown. Texture ranges from fine sandy loam to fine sand. Reaction is moderately alkaline to strongly alkaline. The depth to the water table ranges from 40 to more than 60 inches. Distinct mottles occur at depths below 32 inches in places.

This soil is easy to work and absorbs water readily. It is moderately well drained and has moderately rapid permeability. Runoff is slow, and the hazard of water erosion is slight, but the hazard of soil blowing is moderate. This soil holds 7.5 to 8.0 inches of available water to a depth of 5 feet. Roots penetrate the soil easily to a depth of 5 feet or more.

This soil is mostly used for irrigated crops of alfalfa, sugar beets, small grain, and corn for silage and improved pasture. (Capability unit IIC-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Kidman fine sandy loam, 0 to 2 percent slopes (KdA).—This level or slightly undulating soil is on broad, intermediate lake terraces in the north-central part of Cache Valley. It is similar to Kidman fine sandy loam, deep water table, 0 to 2 percent slopes, except that it is well drained. This soil is on slightly higher areas or areas adjacent to the Bear River. The water table and mottles are at a depth of more than 60 inches. The depth to the horizon of accumulated lime is commonly more than 30 inches.

Included in mapping were small areas of Preston fine sand and a few small areas of moderately well drained Kidman soils.

This soil has moderate permeability. It holds 7.5 to 8.0 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 5 feet or more.

This soil is used for irrigated crops of alfalfa, sugar beets, small grain, corn for silage, and pasture. The principal management need is the control of erosion. (Capability unit IIC-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Kidman fine sandy loam, deep water table, 2 to 4 percent slopes (KfB).—This soil is on medium lake terraces, mostly in the north-central part of Cache Valley. The surface layer ranges from 10 to 16 inches in thickness.

Included in mapping were small areas of Layton loamy fine sand and small areas of well-drained Kidman soils.

This soil is used for irrigated crops and improved pasture. The main crops are alfalfa, sugar beets, small grain, and corn for silage. (Capability unit IIE-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Kidman fine sandy loam, deep water table, 4 to 8 percent slopes (KfC).—This gently undulating soil is on lake terraces, mainly in small areas in the north-central part of Cache Valley. The surface layer is 8 to 12 inches thick. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Layton loamy fine sand. Also included were areas of soils that have a very fine sandy loam surface layer and a few small areas of soils that have slopes of slightly more than 8 percent.

This soil is used mainly for irrigated crops of alfalfa and small grain and for pasture. (Capability unit IIIE-2,

irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Kidman fine sandy loam, 8 to 15 percent slopes (KdD).—This soil is in relatively small, widely separated tracts on terrace breaks, mainly in association with other Kidman soils. It is similar to Kidman fine sandy loam, deep water table, 0 to 2 percent slopes, except that it is more sloping, it is well drained, and the water table is below a depth of 60 inches. The surface layer is 7 to 12 inches thick. Runoff is medium, and the hazard of erosion is moderate.

The soil is used for irrigated crops and pasture. Alfalfa and small grain are the principal crops. (Capability unit IVE-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Kirkham Series

The Kirkham series consists of somewhat poorly drained soils that formed in stratified, calcareous alluvium derived from limestone, sandstone, and quartzite. These soils are on flood plains of the Little Bear and Cub Rivers. Elevation ranges from 4,450 to 4,500 feet, and slopes are 0 to 1 percent. The vegetation is saltgrass, Kentucky bluegrass, sedges, wiregrass, and gumweed. The average annual precipitation is 15 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Kirkham soils are associated with Shay and Winn soils.

In a representative profile, the surface soil is grayish-brown, moderately alkaline silt loam about 9 inches thick. The next layer is grayish-brown, mildly alkaline silty clay loam about 14 inches thick. Below this, to a depth of 60 inches and more, is light brownish-gray, mildly alkaline heavy silt loam that is highly stratified. The profile is strongly calcareous throughout.

Kirkham soils are used for irrigated crops and unimproved pasture.

Kirkham-Shay complex (Ks).—This complex is mostly on the flood plain of the Little Bear and Cub Rivers. About 60 percent of the complex is Kirkham silt loam and about 40 percent is Shay silty clay loam. Slopes range from 0 to 1 percent.

Representative profile of Kirkham silt loam in an area of Kirkham-Shay complex, located north of Richmond, 1,200 feet south and 300 feet west of the northeast corner of sec. 21, T. 14 N., R. 1 E.:

- Ap—0 to 9 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; strongly calcareous; moderately alkaline; abrupt, smooth boundary.
- C1—9 to 15 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many medium pores; strongly calcareous; mildly alkaline; abrupt, smooth boundary.
- C2—15 to 23 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many medium and fine pores; few, fine, distinct mottles; strongly calcareous; mildly alkaline; clear, wavy boundary.

C3—23 to 60 inches, light brownish-gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, sticky and plastic; few fine roots; many fine and medium pores and a few large pores; few, fine, faint mottles; strongly calcareous; mildly alkaline.

The A horizon ranges from dark grayish brown to grayish brown in a hue of 10YR. Texture ranges from silt loam to light silty clay loam. Reaction ranges from mildly alkaline to strongly alkaline. The C horizon ranges from grayish brown or light brownish gray to gray or pale brown in hues of 10YR and 2.5Y. This horizon is highly stratified. It ranges from silty clay loam to silt loam that has thin strata of fine sandy loam or loamy fine sand. In places gravel and sand are at a depth below 40 inches. The water table fluctuates seasonally and with the water level in the streams, but it commonly is at a depth below 30 to 50 inches. In years when runoff is high, this soil is subject to overflow for short periods.

This soil is fairly easy to till. Permeability is moderately slow. Runoff is slow, and the hazard of erosion is slight. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 4 feet or more.

Included in mapping were small areas of Winn silt loam, 0 to 3 percent slopes, and small areas of gravelly alluvial land.

Soils of this mapping unit are used for irrigated crops of sugar beets, alfalfa, small grain, and corn for silage. Some areas are in native pasture. (Capability unit IIw-2, irrigated; Semiwet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Kirkham-Shay complex, strongly alkali (Kt).—This complex is on the Cub River flood plain, mainly near its junction with the Bear River. About 50 percent of the complex is Kirkham silt loam, and about 50 percent is Shay silty clay loam. These soils are similar to other Kirkham and Shay soils, except that they are strongly affected by salt and alkali. In addition, stratification in the profile is not so pronounced and strata of gravel and sand are thin or entirely absent. The surface is uneven and is dotted with oxbows and wet spots.

Included in mapping were small areas of Airport silty clay loam, 0 to 1 percent slopes.

Soils of this mapping unit are used mainly for native pasture. Small areas surrounded by larger tracts of other soils are used for irrigated or dryfarmed crops of alfalfa and small grain. (Capability unit IVw-28, irrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Lakewin Series

The Lakewin series consists of somewhat excessively drained soils. These soils formed in mixed sandy and gravelly alluvium and modified lake sediment derived from limestone, quartzite, and sandstone. They are on old lake bars and medium lake terraces. Elevations range from 4,740 to 4,800 feet, and slopes range from 0 to 3 percent. The vegetation is Indian ricegrass, cheatgrass, annual sunflower, big rabbitbrush, and big sagebrush. The average annual precipitation is 15 to 17 inches, the mean annual air temperature is 46° to 47° F., and the frost-free season is 120 to 140 days. Lakewin soils are associated with Sterling, Ricks, Layton, and Kidman soils.

In a representative profile, the surface layer is dark grayish-brown, neutral to mildly alkaline gravelly coarse sandy loam about 18 inches thick. The next layer is brown, mildly alkaline gravelly loamy sand or gravelly sandy loam about 9 inches thick. Below this is light brownish-gray, strongly calcareous, moderately alkaline gravel and sand to a depth of 60 inches or more.

Lakewin soils are used mainly for dryfarming.

Lakewin gravelly coarse sandy loam (lc).—This soil is on old lake bars or intermediate lake terraces south and west of the city of Hyrum. Slope ranges from 0 to 2 percent.

Representative profile one-half mile east of Sterling Crossroads, 800 feet south of the northwest corner of the northeast quarter of sec. 13, T. 10 N., R. 1 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; 25 percent fine gravel; many fine pores; neutral; clear, smooth boundary.

A1—7 to 18 inches, dark grayish-brown (10YR 4/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; few medium roots and common fine roots; 25 percent gravel; many fine and medium pores; mildly alkaline; clear, wavy boundary.

C1—18 to 27 inches, brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 3/3) when moist; single grain; loose, nonsticky and nonplastic; many fine roots; many fine and medium pores; noncalcareous; 30 percent gravel; mildly alkaline; gradual, wavy boundary.

C2ca—27 to 34 inches, brown (10YR 5/3) gravelly loamy sand, dark brown (7.5YR 3/4) when moist; single grain; loose, nonsticky and nonplastic; common fine roots; slightly calcareous, but strongly calcareous coatings on underside of pebbles; 40 percent gravel; mildly alkaline; clear, wavy boundary.

C3ca—34 to 60 inches, light brownish-gray (10YR 6/2) very gravelly sand, brown (10YR 5/3) when moist; single grain; loose, nonsticky and nonplastic; strongly calcareous; 40 percent gravel; moderately alkaline.

The A horizon ranges from dark grayish brown to brown. Texture ranges from gravelly coarse sandy loam to gravelly sandy loam. The pebbles are mostly less than one-half inch in diameter, and the gravel content ranges from 15 to 30 percent. The C horizon ranges from brown or light brownish gray to light brown or pale brown in a hue of 10YR or 7.5YR. Texture ranges from gravelly loamy sand to gravelly sandy loam in the upper part of the horizon and to gravel and sand in the lower part. Gravel content ranges from 20 to 40 percent in the C1 horizon and from 25 to 75 percent in the C2ca horizon. The underside of many of the pebbles in the C2ca horizon is coated with lime. Reaction ranges from mildly alkaline to strongly alkaline.

Included in mapping were small areas of Kidman fine sandy loam, 0 to 2 percent slopes.

The Lakewin soil is fairly easy to till, but gravel causes excessive wear on tillage implements. Permeability is rapid. Runoff is slow or very slow, and the hazard of erosion is slight. This soil holds 3.0 to 3.75 inches of available water to a depth of 5 feet. Roots are mostly in the upper 2 to 3 feet, and only a few roots extend into the very gravelly material.

This soil is used mainly for dryfarmed crops of small grain. (Capability unit IVs-24, irrigated, VI s-U4, non-irrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2)

LaPlatta Series

The LaPlatta series consists of well-drained soils that formed in residuum derived from light-colored tuff, conglomerate, tuffaceous sandstone, and limestone of the Salt Lake Formation. These soils are on dominantly north- and east-facing mountain slopes at elevations of 5,000 to 7,000 feet. Slopes range from 10 to 50 percent. The vegetation is bluebunch wheatgrass, Great Basin wildrye, tall native bluegrass, Sandberg bluegrass, big sagebrush, bitterbrush, and serviceberry. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 40° to 44° F., and the frost-free season is 80 to 100 days. LaPlatta soils are associated with Barfuss, Leatham, Wheelon, Munk, and Obray soils.

In a representative profile, the surface layer is very dark gray, slightly acid silty clay loam about 8 inches thick. The subsoil is very dark-gray to light brownish-gray, slightly acid or neutral clay about 40 inches thick. The substratum is white, strongly calcareous, strongly alkaline silt loam to a depth of 60 inches or more. Carbonates have been leached from the surface layer and subsoil and redeposited in the substratum.

Representative profile of LaPlatta silty clay loam in an area of Barfuss-Leatham association (30 to 50 percent slopes) approximately 400 feet north and 1,600 feet west of the southeast corner of sec. 5, T. 9 N., R. 1 E.:

- A1—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, granular structure; hard, firm, sticky and slightly plastic; many fine and very fine roots; common, very fine, discontinuous, expd, interstitial pores; slightly acid; clear, smooth boundary.
- B21t—8 to 12 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; strong, medium, subangular blocky structure; very hard, very firm, sticky and plastic; common fine and very fine roots; few very fine tubular pores; few thin clay films on pores; slightly acid; gradual, smooth boundary.
- B22t—12 to 26 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; strong, coarse, prismatic structure; extremely hard, very firm, very sticky and plastic; common fine and very fine roots; few very fine pores; common thin clay films in pores and on ped surfaces; slightly acid; gradual, wavy boundary.
- B23t—26 to 35 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) when moist; strong, coarse, prismatic structure; extremely hard, very firm, very sticky and plastic; few very fine roots; common very fine tubular pores; common thin clay films in pores and on peds; neutral; clear, smooth boundary.
- B3ca—35 to 48 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; common very fine interstitial pores; strongly calcareous, lime is nonindurated, massive, and nodular; strongly alkaline; gradual, wavy boundary.
- Cca—48 to 60 inches, white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) when moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common very fine interstitial pores; very strongly calcareous, lime is nonindurated and massive; strongly alkaline.

The combined thickness of the A1 and B2t horizons ranges from 28 to 40 inches over the horizon of accumulated carbonate. Carbonates generally are in the lower part of the B horizon but, in places, are in only the Cca and C horizons. The A1 horizon ranges from very dark gray to dark gray.

Texture is dominantly silty clay loam but ranges to silt loam. Reaction ranges from slightly acid to mildly alkaline. Thickness is 5 to 11 inches. The B2t horizon ranges from very dark gray or dark grayish brown to grayish brown. Texture ranges from clay or silty clay to heavy silty clay loam. Reaction ranges from slightly acid to mildly alkaline. The soil generally is noncalcareous, but in places it is slightly calcareous in the lower part below a depth of 28 inches. The Cca and C horizons range from white to light grayish brown or pale brown in a hue of 10YR or 2.5Y. Texture ranges from silt loam or very fine sandy loam to silty clay loam. Reaction ranges from mildly alkaline to strongly alkaline, and these horizons are strongly calcareous to very strongly calcareous.

LaPlatta soils are used for range, watershed, and wildlife habitat.

LaPlatta silty clay loam, 30 to 50 percent slopes (LGG).—This steep soil is on north- and east-facing mountain slopes, south of Hardware Ranch and west of Anderson Ranch.

Permeability is moderately slow. Runoff is rapid, and the hazard of erosion is high. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more, but are mostly at a depth of less than 30 inches.

This soil is used for range, watershed, and wildlife habitat. Capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site; not in a woodland suitability group; wildlife suitability group 3)

LaPlatta-Obray association (6 to 30 percent slopes) (LGE).—This mapping unit is mostly in the Davenport Creek and Little Bear River drainage area. A smaller area is on the Clarkston Mountain. About 55 percent of the association is LaPlatta silty clay loam, 10 to 30 percent slopes; 25 percent is Obray silty clay, 6 to 20 percent slopes; 15 percent is Barfuss silt loam, 10 to 30 percent slopes; and 5 percent is included soils.

The strongly sloping to moderately steep LaPlatta soil is on slightly concave mountain slopes. The vegetation is sagebrush, slender wheatgrass, tall native bluegrass, yarrow, geranium, and scattered clumps of scrubby aspen. Runoff is medium, and the hazard of erosion is moderate.

The strongly sloping Obray soil is in terracelike areas between steep slopes. The vegetation is mulesear dock, slender wheatgrass, low sagebrush, and Sandberg bluegrass.

The Barfuss soil is on slightly convex ridges and moderately steep mountain slopes. It is described under the Barfuss series. The vegetation is sagebrush, bitterbrush, Great Basin wildrye, and western wheatgrass. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were areas of a deep, fine-textured, extremely stony soil and areas of Leatham silt loam, 30 to 50 percent slopes. The extremely stony soil makes up 3 percent of the association and is in shallow gullies. The Leatham soil makes up 2 percent of the association and is on convex ridges.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (LaPlatta soil is in capability unit VIe-MN, nonirrigated; Mountain Loam (Shrubs) range site. Obray soil is in capability unit VIe-M5, nonirrigated; Mountain Clay range site. Barfuss soil is in capability unit VIIe-MN; not in a range site. None of the soils is in a woodland suitability group; all of the soils are in wildlife suitability group 3)

Lasil Series

The Lasil series consists of somewhat poorly drained soils that are affected by salt and alkali. These soils formed in mixed lake sediment. They are on low lake terraces at elevations of 4,430 to 4,500 feet. Slopes range from 0 to 3 percent. The vegetation is greasewood, saltgrass, foxtail, gumweed, and annual mustard. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Lasil soils are associated with Jordan, Trenton, and Cache soils.

In a representative profile, the surface layer is light brownish-gray, neutral silty clay loam about 5 inches thick. The subsoil is light brownish-gray, pinkish-gray, and brown, moderately alkaline heavy silty clay loam about 34 inches thick. The substratum is light-brown, moderately alkaline or strongly alkaline heavy silty clay loam to a depth of 60 inches or more.

Representative profile of Lasil silty clay loam in an area of Jordan-Lasil silty clay loams, ½ mile north and ¾ mile west of Amalga Church, 800 feet south and 1,100 feet west of the northwest corner of sec. 24, T. 13 N., R. 1 W.:

- A1—0 to 5 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure that parts to weak, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly calcareous; neutral; abrupt, smooth boundary.
- B1—5 to 13 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly calcareous; moderately alkaline; clear, smooth boundary.
- B21t—13 to 23 inches, pinkish-gray (7.5YR 6/2) heavy silty clay loam, brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure that parts to moderate, fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine pores; thin continuous clay films; slightly calcareous; moderately alkaline; gradual, smooth boundary.
- B22t—23 to 32 inches, pinkish-gray (7.5YR 6/2) heavy silty clay loam, brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure that parts to moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine pores; thin continuous clay films; moderately calcareous; moderately alkaline; gradual, smooth boundary.
- B3ca—32 to 39 inches, brown (7.5YR 5/2) heavy silty clay loam, dark brown to brown (7.5YR 4/2) when moist; weak, medium, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many fine and medium pores; moderately calcareous; moderately alkaline; gradual, smooth boundary.
- Cca—39 to 60 inches, light-brown (7.5YR 6/3) heavy silty clay loam, brown (7.5YR 5/3) when moist; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; massive; very hard, firm, sticky and very plastic; few fine pores; strongly calcareous; moderately alkaline.

The combined thickness of the A1, B1, and B2t horizons ranges from 27 to 33 inches above the ca horizon. The A1 horizon ranges from grayish brown to dark grayish brown or brown. Texture is dominantly silty clay loam but ranges to heavy silt loam. Reaction ranges from neutral to moderately alkaline. Thickness ranges from 3 to 8 inches. The B2t horizon is pinkish gray to brown or to light brown. Texture ranges from heavy silty clay loam to silty clay loam. Reaction is moderately alkaline to very strongly alkaline. The exchangeable sodium percentage ranges from 20 to 50. The Cca horizon

is light brown to pinkish gray. Texture ranges from heavy silt loam to heavy silty clay. Reaction ranges from moderately alkaline to very strongly alkaline. The exchangeable sodium percentage ranges from 20 to 70. The calcium carbonate equivalent is 15 to 30 percent. Distinct, yellowish-red (5YR 5/6) to strong-brown (7.5YR 5/6) mottles are at a depth below 32 inches.

Permeability is very slow. Runoff is slow, and the hazard of erosion is slight to none. These soils hold 3 to 6 inches of available water to a depth of 5 feet. Roots are mostly in the uppermost 20 inches, above the horizon that contains strong alkali.

Lasil soils are mainly used for native range. A few small areas are cultivated.

In this survey area, the Lasil soils are not mapped separately but are mapped in a complex with Jordan soils.

Layton Series

The Layton series consists of moderately well drained soils that formed in mixed lake sediment derived dominantly from sandstone, limestone, and quartzite. These soils are on medium terraces on the Lewiston Bench at elevations of 4,400 to 4,550 feet. Slopes range from 0 to 1 percent. The vegetation is Indian ricegrass, bluebunch wheatgrass, cheatgrass, big rabbitbrush, and big sagebrush. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 130 to 140 days. Layton soils are associated with Kidman, Lewiston, Preston, and Timpanogos soils.

In a representative profile, the surface layer is dark grayish-brown to brown, neutral to mildly alkaline loamy fine sand about 13 inches thick. The next layer is brown, moderately alkaline loamy fine sand about 14 inches thick. The substratum is brown to light-brown, moderately alkaline loamy fine sand and fine sand to a depth of 60 inches or more. Carbonates have mostly been leached from the surface layer and subsoil and accumulated in the substratum at a depth of 36 to 50 inches.

Layton soils are used for irrigated crops of alfalfa, small grain, sugar beets, and corn for silage.

Layton loamy fine sand (lh).—This slightly undulating soil is on lake terraces at medium elevations, mainly in the Lewiston-Cornish area. Slopes are 0 to 1 percent.

Representative profile in an irrigated area, 1¼ miles north and ¾ mile west of Lewiston, 1,000 feet north and 800 feet east of the southwest corner of the southeast quarter of sec. 32, T. 15 N., R. 1 E.:

- Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure to single grain; soft, very friable, nonsticky and nonplastic; many fine roots; neutral; abrupt, smooth boundary.
- A1—6 to 13 inches, brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine pores and few large pores; noncalcareous; mildly alkaline; clear, wavy boundary.
- AC—13 to 27 inches, brown (7.5YR 5/2) loamy fine sand, dark brown (7.5YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; many fine roots; many fine, medium, and large pores; noncalcareous; moderately alkaline; gradual, wavy boundary.

- C1—27 to 35 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many medium and fine pores; noncalcareous; moderately alkaline; gradual, wavy boundary.
- C2—35 to 46 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; common, medium, distinct, yellowish-red (5YR 4/6) mottles; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many fine pores; noncalcareous; moderately alkaline; clear, wavy boundary.
- C3ca—46 to 66 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; common, coarse, distinct, dark reddish-brown (5YR 3/4) mottles; massive; soft, very friable, nonsticky and nonplastic; moderately calcareous; moderately alkaline.

The A horizon ranges from dark grayish brown to grayish brown or to brown in a hue of 10YR. Texture ranges from loamy fine sand to light fine sandy loam. Reaction is neutral to mildly alkaline. Thickness ranges from 6 to 14 inches. The C horizon ranges from brown to light brown or pale brown in a hue of 7.5YR or 10YR. Texture ranges from loamy fine sand to fine sand or to light fine sandy loam. The calcium carbonate equivalent of the C3ca horizon ranges from 8 to 20 percent. Depth to the water table and reddish-brown mottles is most commonly from 40 to 60 inches. In places the substratum is strongly calcareous.

This soil is rapidly permeable. Runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is slight to moderate. This soil holds 5 to 7 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 5 feet.

Included with this soil in mapping were small areas of Layton soils that have slopes of 1 to 3 percent, and areas of well-drained soils.

This soil is used for irrigated crops of alfalfa, small grain, sugar beets, and corn for silage. (Capability unit IIIs-24, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Leatham Series

The Leatham series consists of well-drained soils that formed in material weathered from light-colored, very strongly calcareous, tuff, conglomerate, tuffaceous sandstone, and limestone of the Salt Lake Formation. These soils are mainly on south- and west-facing mountain slopes at elevations of 5,200 to 6,000 feet. Slopes range from 30 to 50 percent. The vegetation is bluebunch wheatgrass, native bluegrass, giant wildrye, cheatgrass, oyster plant, mulesear dock, balsamroot, bitterbrush, big sagebrush, and serviceberry. The average annual precipitation ranges from 20 to 25 inches, the mean annual air temperature is 42° to 45° F., and the frost-free season is 80 to 100 days. Leatham soils are associated with Barfuss, LaPlatta, and Wheelon soils.

In a representative profile, the surface layer is gray, strongly calcareous, neutral silt loam about 10 inches thick. The next layer and the substratum are light-gray to white, very strongly calcareous, mildly alkaline silt loam or light silty clay loam to a depth of 60 inches or more.

Leatham soils are used for range, watershed, and wildlife habitat.

Leatham-Barfuss association, eroded (30 to 50 percent slopes) (LMG2).—This mapping unit is on the rolling foothills east of the Smithfield-Richmond area. About 50 percent of the association is Leatham silt loam, 30 to 50 percent slopes; 20 percent is Barfuss silt loam, 30 to 50

percent slopes; 20 percent is Wheelon silt loam, 30 to 50 percent slopes; and 10 percent is included soils.

Generally the Leatham soil has slopes that face south and west; the Wheelon soil is on convex ridges; and the Barfuss soil is in slightly concave areas and has north-facing slopes. The vegetation on these soils is perennial grasses, forbs, and shrubs.

Representative profile of Leatham silt loam, 30 to 50 percent slopes, in an area of Leatham-Barfuss association, eroded, 1½ miles east of Crow Mountain, 1,000 feet west of the east quarter corner of sec. 12, T. 13 N., R. 1 E.:

- A11—0 to 4 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, platy structure that parts to moderate, fine, granular structure; soft, friable, nonsticky and slightly plastic; many fine, medium, and large roots; many fine pores; strongly calcareous; neutral; abrupt, smooth boundary.
- A12—4 to 10 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure that parts to moderate, fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine, medium, and large roots; many fine and medium pores and a few large pores; strongly calcareous; neutral; clear, wavy boundary.
- AC—10 to 15 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; many fine and medium roots and a few large roots; many fine and medium pores and a few large pores; very strongly calcareous; mildly alkaline; gradual, wavy boundary.
- C1ca—15 to 25 inches, white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky structure; very hard, friable, nonsticky and slightly plastic; many fine and medium roots and a few large roots; many fine and medium pores; very strongly calcareous; mildly alkaline; gradual, wavy boundary.
- C2ca—25 to 39 inches, white (2.5Y 8/1) silty clay loam, light gray (2.5Y 7/2) when moist; massive; very hard, very friable, nonsticky and slightly plastic; few fine roots; many fine and medium pores; very strongly calcareous; mildly alkaline; gradual, irregular boundary.
- C3ca—39 to 60 inches, same as C2ca horizon except that it contains many pockets of weathering volcanic ash that is noncalcareous and has colors lighter than N 8/0; these pockets make up about one-third of the volume of the horizon.

The A horizon ranges from 8 to 12 inches in thickness.

Permeability is moderate. Runoff is rapid, and the hazard of erosion is high. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Included in mapping were areas of LaPlatta silty clay loam, 10 to 30 percent slopes, in depressions and swales.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Leatham soil is in capability unit VIIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2. Barfuss soil is in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site; not in a woodland suitability group; wildlife suitability group 3)

Lewiston Series

The Lewiston series consists of somewhat poorly drained soils that are affected by salt and alkali. These soils formed in mixed lake sediment derived from lime-

stone and sandstone rocks. They are on low lake terraces, mainly in the Lewiston-Trenton area, at elevations of 4,430 to 4,500 feet. Slopes range from 0 to 3 percent. The vegetation is saltgrass, foxtail, alkali sacaton, and Great Basin wildrye. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 130 to 150 days. Lewiston soils are associated with Kidman, Layton, and Trenton soils.

In a representative profile, the surface layer is grayish-brown to brown, mildly alkaline to moderately alkaline very fine sandy loam about 13 inches thick. The next layer is light-gray, moderately alkaline or strongly alkaline fine sandy loam about 19 inches thick. Below this is pinkish-gray, strongly alkaline loamy fine sand to a depth of 60 inches or more.

Lewiston soils are used for irrigated crops and pasture.

Lewiston fine sandy loam (ln).—This soil is mostly on low lake terraces in the vicinity of Lewiston and south to the Benson area. Slopes range from 0 to 3 percent.

Representative profile in a cultivated field, 1¼ miles west and 1¼ miles south of Lewiston, 850 feet north and 110 feet east of the southwest corner of the northeast quarter of sec. 18, T. 14 N., R. 1 E.:

- Ap—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular and weak, coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine pores; slightly calcareous; mildly alkaline; clear, smooth boundary.
- A1—10 to 13 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular and weak, coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine pores; slightly calcareous; moderately alkaline; clear, wavy boundary.
- C1ca—13 to 22 inches, light-gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) when moist; common, medium, faint, grayish-brown (10YR 5/2) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; many fine and medium pores; strongly calcareous; moderately alkaline; clear, smooth boundary.
- C2ca—22 to 32 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; common, medium, faint, yellowish-brown (10YR 5/8) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; few fine pores; strongly calcareous; strongly alkaline.
- C3—32 to 60 inches, pinkish-gray (7.5YR 7/2) loamy fine sand, light brown (7.5YR 6/4) when moist; many, medium, distinct, strong-brown (7.5YR 5/8) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; few fine pores; strongly calcareous; strongly alkaline.

The A horizon ranges from grayish brown to dark grayish brown or to brown. Reaction ranges from mildly alkaline to strongly alkaline. Thickness ranges from 8 to 16 inches. The C and Cca horizons range from brown to pale brown, light brown, or pinkish gray in a hue of 10YR or 7.5YR. Texture ranges from fine sandy loam to light loam or to loamy fine sand. Distinct, yellowish-brown or yellowish-red mottles are in the subsoil and substratum.

This soil is easy to till. Permeability is moderately rapid. Runoff is slow or very slow, and the hazard of erosion is slight. This soil holds 5 to 7 inches of available water to a depth of 5 feet. The water table is at a depth ranging from 30 to 40 inches and fluctuates seasonally. Roots penetrate easily to the water table.

Included in mapping were small areas of Kidman fine sandy loam, deep water table, 0 to 2 percent slopes, a few small areas of soils that have a hardpan, and areas of alkali soils.

This soil is used for irrigated crops of alfalfa, small grain, sugar beets, and corn for silage, and for improved pasture. (Capability unit IIw-26, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Lewiston fine sandy loam, strongly alkali (lo).—This soil is in lower lying areas on low lake terraces. It is similar to Lewiston fine sandy loam, but because of its low position, the water table is higher. The depth to the water table is 10 to 30 inches. This high water table has caused a strong accumulation of alkali and moderate amounts of salts near the surface.

This soil is used for irrigated crops of barley and alfalfa, or for improved pasture or range. (Capability unit IVw-28, irrigated; Alkali Bottom range site; not in a woodland suitability group; wildlife suitability group 1)

Logan Series

The Logan series consists of poorly drained and very poorly drained soils that have a heavy silty clay loam subsoil. These soils formed in mixed alluvium and lake sediment derived from limestone, sandstone, and quartzite. They are on flood plains of streams and low lake terraces at elevations of 4,420 to 4,500 feet. Slopes range from 0 to 3 percent. The vegetation is saltgrass, Kentucky bluegrass, wiregrass, sedges, and cattails. The average annual precipitation is 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 140 days. Logan soils are associated with Roshe Springs, Salt Lake, Cardon, Collett, Greenson, and Airport soils.

In a representative profile, the surface layer is very dark gray, mildly alkaline, strongly calcareous silty clay loam about 13 inches thick. The next layer is gray, moderately alkaline, very strongly calcareous heavy silty clay loam about 13 inches thick. Below this is light-gray, moderately alkaline, strongly calcareous silty clay to a depth of 60 inches or more. The substratum is gleyed.

Logan soils are used mostly for native pasture and meadow hay. Some areas have been drained and are used for irrigated crops of alfalfa, small grain, sugar beets, and corn for silage, and for improved pasture.

Logan silty clay loam (lr).—This soil is in smooth areas or in slight depressions on low lake terraces and flood plains in the central part of Cache Valley. Slopes range from 0 to 3 percent.

Representative profile, located in a wet meadow area, 1 mile south and 1 mile east of Mendon Post Office, 1,100 feet south and 500 feet east of the northwest corner of the northeast quarter of sec. 16, T. 11 N., R. 1 W.:

O2—2 inches to 0, peat.

A1—0 to 13 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, granular structure; slightly hard, friable, sticky and plastic; many fine, medium, and large roots; common fine pores; strongly calcareous; mildly alkaline; gradual, smooth boundary.

C1cag—13 to 26 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam, dark gray (2.5Y 4/1) when moist; mas-

sive; hard, firm, sticky and plastic; common fine roots and few medium roots; many fine and medium pores; very strongly calcareous; moderately alkaline; clear, smooth boundary.

C2g—26 to 45 inches, light-gray (5Y 7/1) silty clay, gray (5Y 6/1) when moist; massive; extremely hard, very firm, very sticky and very plastic; few fine and medium roots; common fine pores; strongly calcareous; moderately alkaline; gradual, wavy boundary.

C3g—45 to 60 inches, light-gray (5Y 7/1) silty clay, olive gray (5Y 5/2) when moist; common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; extremely hard, very firm, very sticky and very plastic; few fine and medium roots; common fine pores; strongly calcareous; moderately alkaline.

A peat horizon as much as 2 inches thick is on the surface in areas where this soil has not been cultivated. The A1 horizon ranges from 10 to 16 inches in thickness and from heavy silt loam to silty clay loam in texture. Mottles of grayish brown to yellowish brown commonly occur below a depth of 20 inches.

This soil is easy to till if it is drained. Permeability is slow. Runoff is slow to ponded, and the hazard of erosion is none to slight. If this soil is drained, it holds 9 to 11 inches of available water to a depth of 5 feet. The depth to the water table commonly is 14 to 40 inches, but some areas are ponded for part of the year. In places this soil has been drained and the water table is below a depth of 40 inches. Most plant roots are above the water table.

Included in mapping were small areas of Greenson loam, 0 to 3 percent slopes, and small areas of Salt Lake silty clay. Also included were a few small areas of soils that are affected by salt and alkali.

This soil is used mainly for meadow hay and pasture. Some small areas are drained and are used for irrigated crops of alfalfa, small grain, sugar beets, and corn for silage. (Capability unit IIIW-25, irrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Lucky Star Series

The Lucky Star series consists of well-drained soils that formed in residuum and colluvium derived dominantly from sandstone. These soils are on mountains at elevations of 7,000 to 8,500 feet. Slopes range from 6 to 60 percent. The vegetation is aspen and an understory of snowberry, chokeberry, mountain brome, blue wildrye, slender wheatgrass, bluebell, peavine, and oniongrass. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is 36° to 46° F., and the mean soil temperature is less than 59°. The frost-free season is 80 to 100 days. Lucky Star soils are associated with Agassiz, Curtis Creek, Despain, Fitzgerald, Flygare, Goring, Hoskin, Mult, Red Spur, and Scout soils.

In a representative profile, the surface layer is very dark grayish-brown, slightly acid gravelly silt loam about 13 inches thick. The subsurface layer is pink, medium acid very cobbly fine sandy loam about 22 inches thick. Below this is a layer of light-brown and reddish-brown, medium acid to slightly acid very cobbly fine sandy loam and very cobbly sandy clay loam about 35 inches thick. The substratum is light-brown, slightly acid very cobbly light loam to a depth of 72 inches or more.

Lucky Star soils are used for range, watershed, woodland, and wildlife habitat.

Lucky Star gravelly silt loam, 30 to 60 percent slopes (LTG).—This soil is on the sides of mountains.

Representative profile, located in south Cottonwood Canyon, 2,400 feet west and 1,800 feet north of the southeast corner of sec. 31, T. 10 N., R. 3 E.:

O1—1 inch to 0, matted leaves and twigs.

A1—0 to 13 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam, very dark brown (10YR 2/2) when moist; weak, very fine, granular structure; soft, very friable, nonsticky and nonplastic; many medium and fine roots and few large roots; 30 percent gravel and cobbles; slightly acid.

A2—13 to 35 inches, pink (7.5YR 7/3) very cobbly fine sandy loam, brown (7.5YR 5/3) when moist; massive; soft, very friable, nonsticky and nonplastic; common medium and very fine roots and few large roots; common medium and fine interstitial pores; 50 to 60 percent cobbles and gravel; medium acid; gradual, irregular boundary.

A2&B2t—35 to 55 inches, mixed A2 and B2t horizons (60 percent A2, and 40 percent B2t); the A2 part is light-brown (7.5YR 6/4) very cobbly fine sandy loam, brown (7.5YR 5/4) when moist; the B2t part is reddish-brown (5YR 5/4) very cobbly sandy clay loam, reddish brown (5YR 4/4) when moist; massive; soft, friable, slightly sticky and nonplastic; common fine and medium roots and few large roots; few medium and many very fine interstitial pores; 50 to 60 percent cobbles and gravel; many clay films in pores and on cobbles and gravel, and very few on ped surfaces; medium acid; clear, wavy boundary.

B2t&A2—55 to 70 inches, mixed B2t and A2 horizons (60 percent B2t, and 40 percent A2); the B2t part is reddish-brown (5YR 5/4) very cobbly sandy clay loam, reddish brown (5YR 4/4) when moist, and the A2 part is light-brown (7.5YR 6/4) very cobbly fine sandy loam, brown (7.5YR 5/4) when moist; moderate, medium, prismatic structure; hard, firm, sticky and plastic; moderately thick continuous clay films on ped surfaces and common moderately thick clay films in pores; few medium and fine roots; common medium and large pores; 50 to 70 percent cobbles and gravel; slightly acid; clear, irregular boundary.

C—70 to 72 inches, light-brown (7.5YR 6/4) very cobbly light loam, mixed brown (7.5YR 5/4) and reddish brown (5YR 4/4) when moist; very cobbly clay loam; massive; soft and hard, friable and firm, nonsticky and sticky, and nonplastic and plastic; few medium and fine roots; many medium and large interstitial pores; 50 to 70 percent cobbles and gravel; slightly acid.

The combined thickness of the A1, A2, and B2t horizons ranges from 50 to 70 inches. The A1 horizon ranges from very dark grayish brown to dark brown in a hue of 10YR or 7.5YR. Reaction ranges from medium acid to neutral. Thickness ranges from 10 to 16 inches. The A2 horizon ranges from pink to light brown, very pale brown, or pale brown in a hue of 10YR, 7.5YR, or 5YR. Texture ranges from very cobbly fine sandy loam or cobbly fine sandy loam to very cobbly loamy fine sand. The A2 horizon tongues into the B2t horizon. The B2t horizon ranges from reddish brown to red or pink in a hue of 7.5YR, 5YR, or 2.5YR. Texture ranges from very cobbly sandy clay loam or very cobbly heavy loam to very cobbly light clay loam. Angular or rounded sandstone and quartzite fragments the size of cobbles and gravel are throughout the profile. The content of coarse fragments ranges from 10 to 30 percent in the A1 horizon, from 30 to 70 percent in the A2 horizon, and from 50 to 80 percent in the B2t and C horizons.

Permeability is moderate. This soil holds about 5 to 7 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more. Runoff is rapid, and the hazard of erosion is high.

Included in mapping were areas of Scave silt loam, 10 to 30 percent slopes, and small areas of soils that have an extremely stony surface layer.

This soil is used for range, watershed, woodland, and wildlife habitat. (Capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2r1; wildlife suitability group 4)

Lucky Star silt loam, 6 to 30 percent slopes (LSE).—This soil is on mountains. It is similar to Lucky Star silt loam, 30 to 60 percent slopes, except that it is not so steep and its surface layer is essentially free of gravel and cobblestones. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in mapping were small areas of Lucky Star gravelly silt loam, 30 to 60 percent slopes, and areas of St. Marys gravelly very fine sandy loam, 30 to 60 percent slopes. Also included are small areas of Scout soils and areas where the surface layer is extremely stony.

This Lucky Star soil is used for range, watershed, woodland, and wildlife habitat. (Capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4)

Lucky Star-Goring association (6 to 30 percent slopes) (LUE).—This mapping unit consists of soils on mountains, mostly west of Ant Flat Road near the Weber County line, and in smaller scattered areas. About 65 percent of the association is Lucky Star silt loam; about 25 percent is Goring silt loam; and 10 percent is included soils.

The Lucky Star soil is similar to Lucky Star gravelly silt loam, 30 to 60 percent slopes, except that it is less sloping and its surface layer is essentially free of gravel and cobblestones. The vegetation is aspen. On the Goring soil the vegetation is grasses, shrubs, and forbs.

Included in mapping were areas of Sheep Creek cobbly loam, 30 to 70 percent slopes, eroded, and Ant Flat loam, 6 to 20 percent slopes.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Lucky Star soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; and wildlife suitability group 4. Goring soil is in capability unit VIe-M, nonirrigated; Mountain Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Lucky Star-Hoskin association (6 to 30 percent slopes) (LVE).—This mapping unit is on the north-facing slopes of mountains in the La Plata mine area. About 70 percent of the association is Lucky Star silt loam, 6 to 30 percent slopes; 25 percent is Hoskin cobbly loam, 10 to 30 percent slopes; and about 5 percent is included soils.

The Lucky Star soil is similar to Lucky Star gravelly silt loam, 30 to 60 percent slopes, except that it is less sloping and its surface layer is essentially free of gravel and cobblestones. The vegetation is aspen.

The Hoskin soil is similar to Hoskin silt loam, 30 to 70 percent slopes, except that it is less sloping and less eroded. The surface ranges from 10 to 15 inches in thickness. Runoff is medium, and the hazard of erosion is moderate. The vegetation is snowberry, chokecherry, and grasses.

Included in mapping were areas of Scout gravelly loam, 10 to 40 percent slopes.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Lucky Star soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group

2o1; wildlife suitability group 4. Hoskin soil is in capability unit VIe-M, nonirrigated; Mountain Stony Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Lucky Star-Red Spur complex, 6 to 30 percent slopes (LWE).—This complex consists of soils on all exposures on the sides of high mountains west of Monte Cristo. Elevation ranges from 7,500 to 8,500 feet. About 45 percent of the complex is Lucky Star silt loam, 6 to 30 percent slopes; about 35 percent is Red Spur loam, 10 to 30 percent slopes; 17 percent is Agassiz rocky silt loam, 6 to 30 percent slopes; and 3 percent is included soils.

The Lucky Star soil is strongly sloping to steep. It is similar to Lucky Star gravelly silt loam, 30 to 60 percent slopes, except that it is less sloping and its surface layer is essentially free of gravel. The vegetation is aspen.

The Red Spur soil is moderately steep to steep. It is described under the Red Spur series. The vegetation is aspen and grass or shrubs and grass. The Agassiz soil is on spur ridges, where the vegetation is shrubs and grass.

Included in mapping were areas of Cluff silt loam, 6 to 30 percent slopes.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4)

Lucky Star-Scout association (6 to 40 percent slopes) (LXE).—This mapping unit is on mountains, mostly north and east of Strawberry Valley. The exposures are mostly northern, but there are spur ridges that have eastern and western exposures. About 65 percent of the association is Lucky Star silt loam, 6 to 30 percent slopes; 25 percent is Scout gravelly loam, 10 to 40 percent slopes; and about 10 percent is included soils.

The Lucky Star soil has slopes that face east and west. It is similar to Lucky Star gravelly silt loam, 30 to 60 percent slopes, except that it is less sloping and its surface layer is essentially free of gravel and cobblestones. The vegetation is aspen.

The Scout soil has slopes that face north. On these slopes the vegetation is conifers.

Included in mapping were areas of St. Marys gravelly very fine sandy loam, 30 to 60 percent slopes, on eastern and western exposures. Here, the vegetation is brush and grass.

Soils in this mapping unit are used for range, watershed, wildlife habitat, and woodland. (Lucky Star soil is in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4. Scout soil is in capability unit VIe-HC, nonirrigated; High Mountain Loam (Conifer) range site; woodland suitability group 4o1; wildlife suitability group 4)

Maughan Series

The Maughan series consists of well-drained soils that have a cobbly clay subsoil. These soils formed in residuum and colluvium derived from sandstone, shale, and limestone rocks. They are on north- and east-facing mountain slopes at elevations of 5,100 to 7,000 feet. Slopes range from 30 to 60 percent. The vegetation is

bigtooth maple and an understory of slender wheatgrass, mountain brome, chokecherry, and scrubby aspen. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 42° to 45° F., and the frost-free season is 100 to 110 days. Maughan soils are associated with Datwyler, Elzinga, Sheep Creek, and Agassiz soils.

In a representative profile, the surface layer is very dark brown and very dark grayish-brown, neutral and slightly acid silt loam about 25 inches thick. The subsurface layer is light-brown, slightly acid, gravelly silt loam about 7 inches thick. The subsoil is reddish-brown cobbly clay and cobbly heavy clay loam to a depth of 66 inches or more.

Representative profile of Maughan silt loam, 30 to 60 percent slopes, in an area of Datwyler-Elzinga-Maughan complex, 30 to 60 percent slopes, 2 miles south and 1 mile west of Sterling crossroads, 500 feet north and 1,200 feet east of the southwest corner of sec. 22, T. 10 N., R. 1 W.:

- A11—0 to 8 inches, very dark brown (10YR 2/2) light silt loam, black (10YR 2/1) when moist; moderate, fine, granular structure; soft, very friable, nonsticky and slightly plastic; many fine, medium, and large roots; 10 percent gravel; neutral; gradual, smooth boundary.
- A12—8 to 25 inches, very dark grayish-brown (10YR 3/2) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots and few large roots; few, fine, interstitial pores; 10 percent gravel; slightly acid; clear, wavy boundary.
- A2—25 to 32 inches, light-brown (7.5YR 6/4) gravelly silt loam, dark brown to brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine and medium roots; many, fine and medium, interstitial and tubular pores; 20 percent gravel; slightly acid; clear, smooth boundary.
- B21t—32 to 38 inches, reddish-brown (5YR 5/4) cobbly heavy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic structure; very hard, very firm, sticky and plastic; common fine and few medium roots; common, fine and medium, interstitial pores; common, thin, continuous clay films in pores; 30 percent gravel and cobblestones; medium acid; gradual, smooth boundary.
- B22t—38 to 50 inches, reddish-brown (5YR 5/4) cobbly clay, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic structure; extremely hard, extremely firm, sticky and very plastic; common fine roots; common, fine, interstitial pores; 30 percent gravel and cobblestones; common, moderately thick, continuous clay films on ped faces; slightly acid; gradual, smooth boundary.
- B23t—50 to 66 inches, reddish-brown (5YR 5/4) cobbly light clay, reddish brown (5YR 4/4) when moist; weak, medium, prismatic structure; very hard, very firm, sticky and plastic; few fine roots; common, fine, interstitial pores; 30 percent weathering limestone cobblestones; common thin clay films in pores and some ped faces; neutral.

The A1 horizon ranges from 20 to 42 inches in thickness. The content of cobblestones and gravel ranges from 0 to 15 percent in the A1 horizon and from 20 to 35 percent in the A2 and B2t horizons. The A1 horizon ranges from very dark brown to dark gray. Reaction ranges from medium acid to neutral. Texture in the A2 horizon is gravelly light silt loam to gravelly heavy loam. Reaction in the A2 horizon is medium acid to slightly acid. The B2t horizon has hues of 7.5YR to 2.5YR. Texture in the B2t horizon ranges from cobbly clay or cobbly silty clay to cobbly heavy clay loam that is more than 35 percent clay. Reaction is medium acid to slightly acid. Thickness ranges from 20 to 40 inches or more.

Permeability is moderately slow to slow. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. These soils hold 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

Maughan soils are used for range, watershed, and wildlife habitat.

Maughan-Datwyler association (30 to 60 percent slopes) (MAG).—This mapping unit is on the north end of the Wellsville Mountains. About 70 percent of the association is Maughan silt loam, 30 to 60 percent slopes, and about 30 percent is Datwyler cobbly silty clay loam, 30 to 60 percent slopes.

The Maughan soil has slopes that face north and east. The vegetation is maple and chokecherry and an understory of grasses and forbs.

The Datwyler soil is on ridges and has south-facing slopes. The vegetation is grass, shrubs, and forbs. In these areas the surface layer ranges from cobbly silty clay loam to gravelly loam.

Soils of this mapping unit are used for range, watershed, and wildlife habitat. (Maughan soil is in capability unit VIIe-MN, nonirrigated; Mountain Loam (Shrubs) range site. Datwyler soil is in capability unit VIIe-M4, nonirrigated; Mountain Stony Loam range site; neither soil is in a woodland suitability group; both are in wildlife suitability group 3)

McMurdie Series

The McMurdie series consists of well-drained soils that formed in mixed lake sediment derived dominantly from limestone, sandstone, and quartzite. These soils are on high lake terraces at elevations of 4,800 to 5,150 feet. Slopes range from 0 to 20 percent. The vegetation is bluebunch wheatgrass, western wheatgrass, cheatgrass, balsamroot, and big sagebrush. The average annual precipitation ranges from 17 to 20 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 130 to 150 days. McMurdie soils are associated with Parleys, Hillfield, Nebeker, Timpanogos, and Ricks soils.

In a representative profile (fig. 5), the surface layer is dark grayish-brown, neutral silt loam about 7 inches thick. The subsoil is dark grayish-brown, brown, and pale-brown, neutral silty clay loam and silty clay about 26 inches thick. The substratum is pale-brown, mildly alkaline, strongly calcareous loam and sandy loam to a depth of 60 inches or more.

McMurdie soils are used for irrigated crops and dry-farmed crops.

McMurdie silt loam, 3 to 6 percent slopes (McB).—This soil is on high lake terraces, mainly near the town of Paradise. Slopes are generally long.

Representative profile, 30 feet east of the northeast corner of Paradise Cemetery, 700 feet north of the southwest corner of the southeast quarter of sec. 27, T. 10 N., R. 1 E.:

- Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure and weak, coarse, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine roots; common fine pores; neutral; abrupt, smooth boundary.
- B1—7 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; mod-

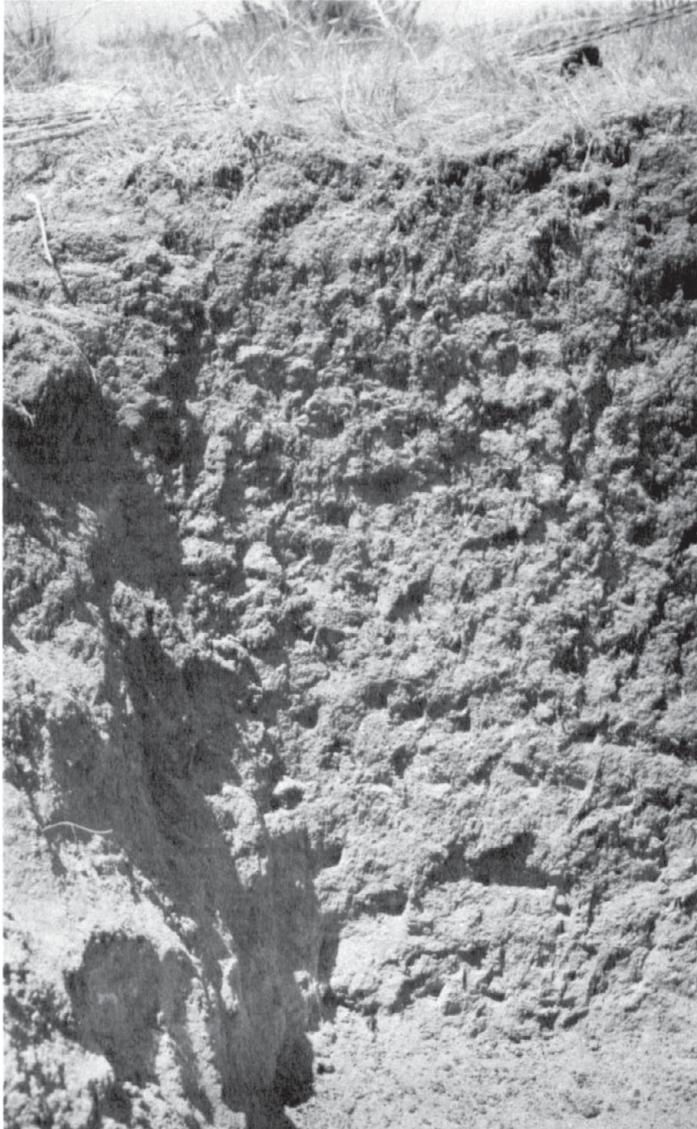


Figure 5.—Profile of McMurdie silt loam, 3 to 6 percent slopes.

erate, medium, subangular blocky structure that parts to moderate, fine, subangular blocky structure; very hard, firm, slightly sticky and plastic; common fine roots; many fine pores; few thin clay films; neutral; clear, wavy boundary.

B2t—14 to 33 inches, brown (7.5YR 5/2) silty clay, dark brown (7.5YR 3/2) when moist; strong, medium, prismatic structure that parts to strong, medium, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; common fine roots; common fine pores; common moderately thick clay films; neutral; clear, wavy boundary.

B3ca—33 to 43 inches, pale-brown (10YR 6/3) silty clay loam, brown (7.5YR 5/4) when moist; weak, medium, prismatic structure that parts to moderate, medium, angular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine and medium pores; few thin clay films; strongly calcareous; neutral; clear, wavy boundary.

C1ca—43 to 50 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; hard, firm, sticky and plastic; few fine roots; common fine and medium pores; strongly calcareous; mildly alkaline; abrupt, smooth boundary.

IIC2—50 to 60 inches, pale-brown; (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; massive; soft, very friable, nonsticky and nonplastic; strongly calcareous; mildly alkaline.

The A horizon ranges from dark grayish brown to brown or grayish brown. Texture ranges from silt loam to light silty clay loam. Thickness ranges from 7 to 12 inches. The B2t horizon ranges from brown to light brown in hues of 7.5YR and 10YR. Texture ranges from silty clay to heavy clay loam or heavy silty clay loam. Thickness ranges from 15 to 30 inches. The Cca and C horizons range from pale brown to brown or light brown in hues of 10YR and 7.5YR. Texture ranges from silty clay loam to sandy loam. Reaction is neutral to mildly alkaline, and the horizon is strongly calcareous. The ca horizon generally begins in the lower part of the B horizon.

Included in mapping were small areas of Hillfield silt loam. Also included were small areas of soils that have slopes of 1 to 3 percent and soils that have a silty clay loam surface layer.

This soil is fairly easy to till. Permeability is moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 5 feet or more.

This soil is used mostly for irrigated crops of alfalfa, small grain, and sugar beets. Some areas are used for dryfarmed crops. (Capability unit IIe-2, irrigated, IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

McMurdie silt loam, 0 to 3 percent slopes (McA).—This soil is on high lake terraces along the east side of Cache Valley. It is similar to McMurdie silt loam, 3 to 6 percent slopes, except that it is less sloping and its surface layer is 8 to 18 inches thick. Runoff is slow, and the hazard of erosion is none to slight.

This soil is used for irrigated crops. Alfalfa, small grain, sugar beets, peas, and corn for silage are common crops. (Capability unit IIc-2, irrigated, IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

McMurdie silt loam, 6 to 10 percent slopes (McC).—This soil is on high lake terraces. It is associated with McMurdie silt loam, 3 to 6 percent slopes, and is similar to that soil, except that it is more sloping. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Hillfield silt loam. Also included were small areas of soils that have slopes of slightly more than 10 percent.

This soil is used mainly for irrigated crops of alfalfa and small grain. Small areas are dryfarmed. (Capability unit IIIe-2, irrigated, IIIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

McMurdie-Hillfield silt loams, 10 to 30 percent slopes, eroded (McE2).—This complex consists of strongly undulating and rolling soils on high lake terrace escarpments east of the town of Paradise. About 60 percent of the complex is McMurdie silt loam, 10 to 20 percent slopes, and about 40 percent is Hillfield silt loam, 20 to 30 percent slopes, eroded. Runoff is rapid, and the hazard of erosion is high.

The McMurdie soil is on north-facing slopes or the lower part of south-facing slopes and in swales. It is similar to McMurdie silt loam, 3 to 6 percent slopes, except that it is more strongly sloping, it is moderately

eroded, and the surface layer is 7 to 8 inches thick. In places tillage has exposed the subsoil.

The Hillfield soil is on convex ridges and the upper part of south-facing slopes.

Soils of this mapping unit are used for dryfarmed crops of alfalfa and winter wheat. (McMurdie soil is in capability unit IVE-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3. Hillfield soil is in capability unit VIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Mendon Series

The Mendon series consists of well-drained soils that have a clay loam subsoil. These soils formed in alluvium and colluvium derived from light-colored tuff, conglomerate, tuffaceous sandstone, and limestone of the Salt Lake Formation. They are on lake terraces or rolling dissected foothills along the west side of Cache Valley and extend from the vicinity of Clarkston southward to Hyrum Reservoir. Elevations range from 4,500 to 5,100 feet, and slopes range from 0 to 20 percent. The vegetation is bluebunch wheatgrass, western wheatgrass, balsamroot, and big sagebrush. The average annual precipitation ranges from 17 to 20 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is

120 to 150 days. Mendon soils are associated with Avon (fig. 6), Collinston, Wheelon, and Crookston soils.

In a representative profile (fig. 7), the surface layer is dark-gray, neutral silt loam about 7 inches thick. The subsoil is grayish-brown, neutral clay loam about 21 inches thick. The substratum is white and light brownish-gray, strongly calcareous, mildly alkaline loam to a depth of 60 inches or more.

Mendon soils are used mostly for dryfarming, but some areas are used for irrigated crops.

Mendon silt loam, 3 to 6 percent slopes (MeB).—This soil is on the gently undulating intermediate lake terraces. It is mainly along the west side of Cache Valley but also is on the east side between the towns of Richmond and Smithfield.

Representative profile, about 2 miles north and 1 mile west of Newton, 700 feet north and 40 feet west of the southeast corner of the southwest quarter of sec. 1, T. 13 N., R. 2 W.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; mixed weak, medium, subangular blocky and weak, fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; few fine roots; few fine pores; neutral; abrupt, smooth boundary.

B2t—7 to 24 inches, grayish-brown (10YR 5/2) clay loam, very dark gray (10YR 3/1) when moist; moderate, medium, prismatic structure that parts to moderate,



Figure 6.—Area of Mendon and Avon soils west of Mendon Cemetery. Collinston, Mendon, and Hiibner soils are on the upper lake terraces in the background, and Smarts and Lucky Star soils are dominant on the mountain.



Figure 7.—Profile of Mendon silt loam, 3 to 6 percent slopes.

medium, subangular blocky structure; very hard, very firm, very sticky and plastic; common fine roots; many fine pores; common thin clay films; neutral; clear, smooth boundary.

B3ca—24 to 28 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular structure; very hard, friable, sticky and plastic; common fine roots; few fine pores; few thin clay films; strongly calcareous; mildly alkaline; gradual, wavy boundary.

C1ca—28 to 34 inches, white (10YR 8/2) loam, pale brown (10YR 6/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine and medium pores; very strongly calcareous; mildly alkaline; gradual, wavy boundary.

C2—34 to 40 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine, medium, and large pores; strongly calcareous; mildly alkaline; gradual, wavy boundary.

C3—40 to 60 inches, white (2.5Y 8/2) loam, light brownish gray (2.5Y 6/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; no roots; common fine and medium pores; strongly calcareous; mildly alkaline.

The A horizon ranges from dark gray to very dark gray in a hue of 10YR or 2.5Y. Texture is dominantly silt loam but is light silty loam in places. Reaction is neutral to mildly alkaline, and the horizon generally is noncalcareous but is slightly calcareous in places because of recent deposition or rodent activity. Thickness ranges from 7 to 11 inches. The B2t horizon ranges from grayish brown to gray or dark grayish brown in a hue of 10YR or 2.5Y. Texture is clay loam to silty clay loam. Reaction is neutral to mildly alkaline. Thickness ranges from 8 to 18 inches. The C horizon ranges from white to light brownish gray or pale brown in a hue of 2.5Y or 10YR. Texture ranges from silt loam or loam to silty clay loam.

This soil is easy to till. Permeability is moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 5 feet.

Included in mapping were small areas of Collinston silt loam, 1 to 6 percent slopes, and small areas of Wheelon silt loam. Also included were few small areas of gravelly loam on ridges, particularly in the Newton and North Clarks-ton area.

This soil is used mainly for dryfarmed crops of alfalfa, winter wheat, and safflower. Small areas are irrigated. Alfalfa, small grain, and sugar beets are grown. (Capability unit IIe-2, irrigated, IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Mendon silt loam, 0 to 3 percent slopes (MeA).—This slightly undulating soil is on medium lake terraces. Except for slope, it is similar to Mendon silt loam, 3 to 6 percent slopes. The surface layer is 10 to 17 inches thick. Run-off is slow, and the hazard of erosion is slight.

This soil is used mainly for dryfarmed crops of alfalfa, winter wheat, and safflower. Small areas are irrigated. Sugar beets, alfalfa, and small grain are grown in these areas. (Capability unit IIc-2, irrigated; IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Mendon silt loam, 6 to 10 percent slopes (MeC).—This soil is on medium and high terraces. It is similar to Mendon silt loam, 3 to 6 percent slopes, except that it is more sloping and its surface layer is 7 to 10 inches thick. In places tillage has exposed the subsoil. Strong lime horizons are present at a depth of 20 to 24 inches. Runoff is medium, and the hazard of erosion is moderate. Most runoff is during intense thunderstorms or when snow melts exceptionally fast.

Included in mapping were small areas of Wheelon silt loam and small areas of gravelly soils.

This soil is used mostly for dryfarmed crops of alfalfa, alfalfa-grass mixture, winter wheat, and safflower. Small areas are sprinkler irrigated. (Capability unit IIIe-2, irrigated; IIIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Mendon-Collinston complex, 1 to 6 percent slopes (MfB).—This complex consists of strongly undulating soils on medium and high lake terraces along the west side of Cache Valley. About 45 percent of the complex is Mendon silt loam, 3 to 6 percent slopes; 45 percent is Collins-

ton loam, 1 to 6 percent slopes; and about 10 percent is included soils.

The Mendon soil is more gently sloping than the Collinston soil and commonly has slopes that face north. It is similar to Mendon silt loam, 3 to 6 percent slopes, except that the surface layer is 6 to 17 inches thick and is slightly calcareous in places. It is calcareous because of the deposition of calcareous material eroded from adjacent Collinston and Wheelon soils.

The Collinston soil has south- and east-facing slopes.

Included in mapping were areas of Wheelon silt loam that are on convex ridges and the steeper slopes of the complex. Also included were small areas of soils that have slopes of 6 to 15 percent and small gravelly areas that are associated with the Wheelon soil on the ridgetops.

Soils of this mapping unit are used for dryfarmed crops. Winter wheat (fig. 8) and alfalfa are common crops. (Capability unit IIIe-U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Mendon-Collinston complex, 6 to 30 percent slopes, eroded (MfE2).—This complex consists of strongly undulating or rolling soils on high lake terraces along the

west side of Cache Valley. About 40 percent of the complex is Mendon silt loam, 6 to 10 percent slopes; 40 percent is Collinston loam, 10 to 30 percent slopes, eroded; and 20 percent is Wheelon silt loam, 10 to 30 percent slopes, eroded.

The Mendon soil generally is at the base of north-facing slopes and in depressions. It is similar to Mendon silt loam, 3 to 6 percent slopes, except that it is more sloping and its surface layer is slightly calcareous in places.

The Collinston soil generally is on moderately steep south-facing slopes and the upper part of north-facing slopes. It is similar to Collinston loam, 6 to 10 percent slopes, described under the Collinston series, except that it is steeper and is moderately eroded.

The Wheelon soil is on moderately steep, convex slopes and ridgetops.

Included in mapping were areas of soils that have a silty clay loam surface layer.

Soils of this mapping unit are used mostly for dryfarmed crops of winter wheat, alfalfa, and safflower. (Capability unit VIe-U, nonirrigated; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)



Figure 8.—Wheat stubble on the Mendon soil of the Mendon-Collinston complex, 1 to 6 percent slopes. Soils of the Mendon-Collinston complex, 6 to 30 percent slopes, eroded, are on the high lake terraces in the background.

Middle Series

The Middle series consists of well-drained, cobbly soils. The depth to bedrock ranges from 24 to 40 inches. These soils formed in residuum and colluvium derived from limestone, quartzite, and sandstone. They are on west- and south-facing mountain slopes at elevations of 5,000 to 6,500 feet. The slopes range from 30 to 70 percent. The vegetation is big sagebrush, low sagebrush, yellowbrush, bitterbrush, slender wheatgrass, bluebunch wheatgrass, prairie junegrass, and scattered juniper. The average annual precipitation ranges from 17 to 20 inches, the mean annual air temperature is 45° to 48° F., and the frost-free season is 110 to 130 days. Middle soils are associated with Richmond soils.

In a representative profile, the surface layer is grayish-brown, mildly alkaline cobbly light loam about 7 inches thick. The subsoil is brown and light yellowish-brown, mildly alkaline and moderately alkaline cobbly loam and very cobbly loam about 13 inches thick. The substratum is pink and light-brown, moderately alkaline very cobbly heavy sandy loam about 8 inches thick over limestone bedrock.

Representative profile of Middle cobbly loam, 30 to 70 percent slopes, in an area of Richmond-Middle association, eroded, in Box Elder County, on the west face of Wellsville Mountain, Cache National Forest, in the northeast quarter of the southwest quarter of the northeast quarter of sec. 9, T. 11 N., R. 2 W.:

- A1—0 to 7 inches, grayish-brown (10YR 5/2) cobbly light loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure that parts to weak, very fine, granular structure; soft, very friable, nonsticky and nonplastic; many micro and very fine roots and common fine roots; 30 percent channery limestone, cobblestones 3 to 6 inches in length; mildly alkaline; clear, wavy boundary.
- B21—7 to 15 inches, brown (10YR 5/3) cobbly loam, dark brown to brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few thin clay films; common fine and very fine roots; few very fine pores; 40 percent angular cobblestones and 10 percent angular gravel; slightly calcareous; mildly alkaline; clear, wavy boundary.
- B22—15 to 20 inches, light yellowish-brown (10YR 6/4) very cobbly loam, dark brown to brown (10YR 4/3) when moist; moderate, coarse, subangular blocky structure that parts to moderate, medium and fine, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; common thin clay films on ped faces and in pores; 50 percent angular gravel; moderately calcareous; moderately alkaline; abrupt, wavy boundary.
- Cca—20 to 28 inches, pink and light-brown (7.5YR 7/4 and 6/4) very cobbly heavy sandy loam, strong brown (7.5YR 4/6) when moist; weak, fine, subangular blocky structure that parts to weak, very fine, subangular blocky structure and single grain; slightly hard, very friable, nonsticky and nonplastic; few fine roots; 60 percent angular cobblestones; strongly calcareous; moderately alkaline.
- R—28 inches, limestone rock.

The thickness of the solum and the depth to horizons of carbonate accumulation range from 16 to 28 inches. Coarse fragments range from 20 to 50 percent gravel and cobblestones in the A horizon, 40 to 80 percent cobblestones, gravel, and stones in the B2t horizon, and 50 to 90 percent cobble-

stones and stones in the C horizon. Coarse fragments are angular sandstone, limestone, and quartzite rock fragments. The A horizon ranges from grayish brown to brown. Texture is gravelly loam or cobbly loam. Reaction ranges from neutral to moderately alkaline, and the horizon is noncalcareous to slightly calcareous. Thickness ranges from 7 to 12 inches. The B2 horizon ranges from brown to pale brown or grayish brown. Texture is very gravelly loam or cobbly loam to very cobbly loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is noncalcareous to moderately calcareous. The C horizon ranges from pink to brown or grayish brown in hues of 10YR and 7.5YR. Texture ranges from very cobbly sandy loam to heavy loam. The matrix of the C horizon is moderately calcareous to strongly calcareous and has lime enrichment in the upper part. The calcium carbonate equivalent ranges from 4 to 40 percent.

Permeability is moderate. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. These soils hold 3 to 4 inches of available water above the bedrock. Roots generally extend to the bedrock, but some roots extend into cracks in the bedrock.

Middle soils are used for watershed, range, and wildlife habitat.

In the Cache Area, the Middle soils are mapped only in an association with the Richmond soils.

Millville Series

The Millville series consists of well drained and moderately well drained, very strongly calcareous soils. These soils formed in alluvium derived from dolomitic limestone. They are on alluvial fans deposited on high and medium lake terraces between the towns of Smithfield and Providence at elevations of 4,500 to 5,100 feet. Slopes range from 0 to 6 percent. The vegetation is big sagebrush, bluebunch wheatgrass, bluegrass, cheatgrass, and gumweed. The average annual precipitation ranges from 15 to 17 inches, the mean annual temperature is 47° to 49° F., and the frost-free season is 140 to 160 days. Millville soils are associated with Green Canyon, Timpanogos, Parleys, Greenson, and Nibley soils.

In a representative profile, the surface layer is dark grayish-brown and grayish-brown silt loam about 12 inches thick. This is underlain by light brownish-gray, pale-brown, and light-gray silt loam that extends to a depth of 60 inches or more. The entire profile is moderately alkaline and very strongly calcareous.

Millville soils are used mainly for irrigated crops.

Millville silt loam, 2 to 4 percent slopes (M1B).—This soil is on alluvial fans, chiefly in the North Logan-Smithfield area.

Representative profile in a cultivated area, one-fourth mile north of the Utah State University Dairy Farm Headquarters, 40 feet north and 100 feet west of the northeast corner of the southeast quarter of sec. 22, T. 12 N., R. 1 E.:

- Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; few medium pores; very strongly calcareous; moderately alkaline; gradual, smooth boundary.
- A12—6 to 12 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; very weak, medium, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; very strongly calcareous; moderately alkaline; gradual, smooth boundary.

AC—12 to 24 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; very strongly calcareous; moderately alkaline; gradual, smooth boundary.

C1—24 to 35 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; very strongly calcareous; moderately alkaline; gradual, smooth boundary.

C2—35 to 65 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; very strongly calcareous; moderately alkaline.

The A1 horizon ranges from dark grayish brown to brown in a hue of 10YR. Reaction is moderately alkaline to mildly alkaline, and the horizon is strongly calcareous or very strongly calcareous. Thickness ranges from 7 to 15 inches. The C horizon ranges from pale brown to light gray or light brownish gray in a hue of 10YR or 2.5Y.

This soil is easy to till. It is well drained, and permeability is moderate. Runoff is slow, and the hazard of erosion is slight. This soil holds 8 to 10 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 5 feet or more.

Included in mapping were small areas of Green Canyon gravelly loam, 0 to 3 percent slopes, and areas of slightly steeper soils. Also included are small areas of moderately well drained Millville soils.

This soil is used mostly for irrigated crops of alfalfa, sugar beets, small grains, peas, pole beans, and corn for silage. (Capability unit IIe-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Millville silt loam, 0 to 2 percent slopes (MIA).—This soil is similar to Millville silt loam, 2 to 4 percent slopes, except that it is more gently sloping and has a fluctuating water table between depths of 40 and 50 inches during the growing season. It is moderately well drained. Strong-brown to light olive-brown mottles are present in the lower subsoil and substratum.

Included in mapping were small gravelly areas and small areas of a silty clay loam.

This Millville soil is used for irrigated crops of alfalfa, small grain, sugar beets, peas, pole beans, and corn for silage. (Capability unit IIw-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Mixed Alluvial Land

Mixed alluvial land (Mm) is a miscellaneous land type consisting of stratified, dominantly sandy alluvial soil material deposited along the flood plain of the Bear River, Blacksmith Fork River, and other streams. The area is characterized by many oxbows and wet spots. It is subject to overflow during periods of high runoff in spring. Little or no profile formation has taken place, but mottling is evident in the substratum. Grass, weeds, and willows are established in some places, and the area has limited use for grazing. The principal use is for wildlife habitat. (Capability unit Vw-2, nonirrigated; Wet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Mult Series

The Mult series consists of well-drained soils. Fractured limestone bedrock is at a depth of 22 to 40 inches. These soils formed in colluvium and residuum derived dominantly from limestone. They are on north- and east-facing mountain slopes at elevations of 6,800 to 9,500 feet. Slopes range from 6 to 50 percent. The vegetation is aspen and scattered conifers and an understory of snowberry, slender wheatgrass, mountain brome, and blue wildrye. The average annual precipitation ranges from 25 to 30 inches, the average annual air temperature is 36° to 42° F., and the frost-free season is 70 to 90 days. Mult soils are associated with Bickmore, Lucky Star, Dateman, Agassiz, and Elwood soils.

In a representative profile, the surface layer is brown, slightly acid and medium acid heavy silt loam, about 14 inches thick, that has a moderate to moderately high organic-matter content. The subsoil is yellowish-brown, medium acid silty clay loam about 10 inches thick. Fractured limestone bedrock is at a depth of about 24 inches. Carbonates have been leached from the surface layer and subsoil. The base saturation percentage ranges from 70 to 85 percent.

Mult soils are used for watershed, wildlife habitat, woodland, and range.

Mult-Agassiz association (MNE).—This mapping unit is in the upper areas of LaPlatta Creek, Davenport Creek, and South Cottonwood. The soils are on mountain slopes that have many side drainageways. The exposed rock formations are limestone. About 40 percent of the association is Mult silt loam, 6 to 30 percent slopes; 40 percent is Agassiz rocky silt loam, 6 to 30 percent slopes; and 20 percent is Elwood silt loam, 10 to 30 percent slopes.

The Multi soil is predominantly on north-facing slopes in basinlike pockets where the vegetation is aspen. The Agassiz soil is on south-, east-, and west-facing slopes of ridges. Here, the vegetation is shrubs, grass, and a few coniferous trees. The Elwood soil has north- and east-facing slopes. Depth to bedrock ranges from 22 to 40 inches. The vegetation is Douglas-fir and alpine fir.

Representative profile of Mult silt loam, 6 to 20 percent slopes, in an area of Mult-Agassiz association in South Cottonwood Canyon, 1,600 feet south and 1,200 feet east of the northwest corner of sec. 30, T. 10 N., R. 3 E.:

A11—0 to 4 inches, brown (10YR 4/3) heavy silt loam, very dark brown (10YR 2/3) when moist; moderate, fine, granular structure; soft, friable, nonsticky and slightly plastic; many fine roots and common medium roots; slightly acid; abrupt, wavy boundary.

A12—4 to 14 inches, brown (10YR 4/3) heavy silt loam, dark brown (10YR 3/3) when moist; strong, medium and coarse, granular structure; slightly hard, friable, slightly sticky and plastic; many fine roots and common medium roots; common, very fine, discontinuous, random, inped and exped, interstitial and tubular pores; medium acid; clear, smooth boundary.

B21t—14 to 24 inches, light yellowish-brown (10YR 6/4) silty clay loam, dark brown to brown (10YR 4/3) when moist; moderate, fine and medium, subangular blocky structure; slightly hard, firm, sticky and plastic; common, very fine, discontinuous, random, inped and exped, interstitial and tubular pores; common fine and medium roots; thin continuous clay films on peds and moderately thick continuous clay films in pores;

tongues of A12 material extend through this horizon; medium acid; clear, broken boundary.

R—24 inches, fractured limestone rock.

The A1 horizon ranges from brown to grayish brown in hues of 10YR and 7.5YR. Texture ranges from silt loam or loam to light silty clay loam. Thickness ranges from 8 to 16 inches. The B2t horizon ranges from yellowish brown or light brown to brown or reddish brown in hues of 10YR to 5YR. Texture ranges from silty clay loam or clay loam to heavy silt loam. Reaction ranges from medium acid to mildly alkaline. The lower part of the B2t horizon is slightly calcareous in places.

Permeability of the Mult soil is moderate. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 5 to 7 inches of available water above the bedrock. Roots are mostly in the surface 20 to 40 inches above the bedrock. Some roots extend into cracks in the bedrock.

Soils of this mapping unit are used for range, watershed, wildlife habitat, and woodland. (Mult soil is in capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Mult-Agassiz association, eroded (30 to 70 percent slopes) (MNG2).—This mapping unit is east of the Logan River in the Franklin Basin area. The soils are on southwest-facing mountain slopes that are dissected somewhat by canyons and drainages. The elevation ranges from 6,500 to 7,200 feet. About 50 percent of the association is Mult silt loam, 30 to 50 percent slopes; 45 percent is Agassiz rocky silt loam, 30 to 70 percent slopes, eroded; and about 5 percent is included soils.

The Mult soil generally has concave slopes that face east. This soil is similar to Mult silt loam, 6 to 30 percent slopes, except that it has slopes of 30 to 50 percent. The surface layer ranges from 11 to 14 inches in thickness, and the depth to bedrock ranges from 30 to 40 inches. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The vegetation is aspen.

The rocky Agassiz soil has slopes that face south and west. The vegetation is big sagebrush and curleaf mountain-mahogany.

Included in mapping were areas of Elwood silt loam, 30 to 60 percent slopes. This soil generally has an easterly exposure. The vegetation is Douglas-fir and alpine fir.

Soils of this mapping unit are used for range, watershed, wildlife habitat, and woodland. (Mult soil is in capability unit VIIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Mult-Lucky Star association (6 to 30 percent slopes) (MSE).—This mapping unit consists of soils on mountain slopes in the upper LaPlatta Creek area. About 35 percent of the association is Mult silt loam, 6 to 30 percent slopes; 30 percent is Lucky Star silt loam, 6 to 30 percent slopes; 30 percent is Agassiz rocky silt loam, 6 to 30 percent slopes; and about 5 percent is included soils.

The Mult and Lucky Star soils are on all exposures. The vegetation is aspen. The Agassiz soil is on east-,

south-, and west-facing ridges. The vegetation is sagebrush.

Soils of this mapping unit are used for range, watershed, wildlife habitat, and woodland. (Mult and Lucky Star soils are in capability unit VIe-HA, nonirrigated; High Mountain Loam (Aspen) range site; woodland suitability group 2o1; wildlife suitability group 4. Agassiz soil is in capability unit VIIs-MX3, nonirrigated; Mountain Shallow Loam range site; not in a woodland suitability group; wildlife suitability group 3)

Munk Series

The Munk series consists of well-drained soils that formed in light-colored tuff, tuffaceous sandstone, and limestone. Depth to bedrock is 20 to 40 inches. These soils are on mountain slopes, mainly along the west side of Cache Valley at elevations of 4,500 to 5,700 feet. Slopes range from 30 to 70 percent. The vegetation is bluebunch wheatgrass, sagebrush, yellowbrush, oyster plant, and bitterbrush. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the average frost-free season is 120 to 140 days. Munk soils are associated with Blackrock, Colinston, and Wheelon soils.

In a representative profile, the surface layer is grayish-brown, moderately alkaline gravelly loam about 8 inches thick. The next layer is light brownish-gray, moderately alkaline very gravelly loam about 15 inches thick. The substratum is white, very strongly calcareous, strongly alkaline very gravelly sandy loam that is underlain by bedrock at a depth of about 36 inches.

Munk soils are used for range, watershed, and wildlife habitat.

Munk-Blackrock gravelly loams, 30 to 70 percent slopes, eroded (MoG2).—This complex is on mountain slopes along the west side of Cache Valley. About 60 percent of the complex is Munk gravelly loam, 30 to 70 percent slopes, eroded; and 40 percent is Blackrock gravelly loam, 30 to 60 percent slopes.

The Munk soil is on south- and west-facing side slopes and ridges. It is moderately eroded.

The Blackrock soil has slopes that face north and east.

Representative profile of Munk gravelly loam in an area of Munk-Blackrock gravelly loams, 30 to 70 percent slopes, eroded, in a range area, approximately 600 feet south and 200 feet west of the northeast corner of the southeast quarter of sec. 7, T. 14 N., R. 1 W.:

A1—0 to 8 inches, grayish-brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; common fine pores; 40 percent gravel; moderately calcareous; moderately alkaline; clear, smooth boundary.

AC—8 to 23 inches, light brownish-gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to moderate, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine pores; 50 percent gravel; strongly calcareous; moderately alkaline; abrupt, smooth boundary.

Cca—23 to 36 inches, white (10YR 8/2) very gravelly sandy loam, light brownish gray (10YR 6/2) when moist; massive; soft, very friable; nonsticky and nonplastic;

few fine roots; approximately 50 to 60 percent gravel; very strongly calcareous; strongly alkaline; abrupt, smooth boundary.

R—36 inches, partially consolidated bedrock (Salt Lake Geologic Formation material).

The A1 horizon ranges from grayish brown to brown, dark brown, or light olive brown in a hue of 10YR or 2.5Y. Texture is gravelly loam to gravelly silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is moderately calcareous to strongly calcareous. Thickness ranges from 7 to 10 inches. The transitional AC horizon ranges from light brownish gray to brown, pale brown, or light yellowish brown in a hue of 10YR or 2.5Y. Texture is very gravelly loam to gravelly loam or very gravelly silt loam. Reaction is mildly alkaline to moderately alkaline, and the horizon is strongly calcareous to moderately calcareous. Thickness ranges from 6 to 15 inches. The Cca and C horizons range from white to light yellowish-brown in hues of 10YR and 2.5Y. Texture ranges from very gravelly sandy loam to very gravelly loam. Reaction is moderately alkaline to strongly alkaline, and the horizon is strongly calcareous to very strongly calcareous. In places 10 percent cobblestones are on the surface and throughout the profile. The depth to bedrock ranges from 20 to 40 inches. In places the ca horizon is weakly to moderately cemented. Coarse fragments are mostly gravel- and cobblestone-size, rounded to slightly angular limestone rock fragments and range in volume from 20 to 50 percent in the A1 horizon and from 50 to 70 percent in the Cca and C horizons.

Permeability is moderate. Runoff is rapid or very rapid, and the hazard of erosion is high to very high. The available water holding capacity is 2 to 4 inches above bedrock.

Included in mapping were a few areas of deep and moderately deep, light-colored loamy soils and small areas of limestone rock outcrops.

These soils are used for range. Erosion control and proper range use are the principal management needs. (Munk soil is in capability unit VIIIs-U4, nonirrigated; Upland Stony Loam range site; not in a woodland suitability group; wildlife suitability group 2. Blackrock soil is in capability unit VIIIs-U4; Upland Loam range site; not in a woodland suitability group; wildlife suitability group 2)

Nebeker Series

The Nebeker series consists of well-drained soils that have a clay subsoil. These soils formed in noncalcareous alluvium derived from sandstone, quartzite, and shale. They are on coalescing alluvial fans at elevations of 5,100 to 5,700 feet. Slopes range from 3 to 40 percent. The vegetation is slender wheatgrass, western wheatgrass, big sagebrush, bitterbrush, and mulesear dock. The average annual precipitation ranges from 17 to 20 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 110 to 140 days. Nebeker soils are associated with McMurdie, Hiibner, Parleys, Richmond, and Hendricks soils.

In a representative profile, the surface layer is dark grayish-brown, slightly acid silt loam, about 8 inches thick, that has a moderately high organic-matter content. The subsoil is brown, slightly acid silt loam and silty clay loam about 47 inches thick. The substratum is brown, mildly alkaline clay loam to a depth of 60 inches or more.

Nebeker soils are used for dryfarmed crops, irrigated crops, and range.

Nebeker silt loam, 10 to 25 percent slopes (NbE).—This soil is on old fans just above the highest level of ancient Lake Bonneville.

Representative profile in a cultivated area, 1 mile north and 1½ miles east of Paradise, 20 feet north and 100 feet west of the southeast corner of the southwest quarter of sec. 14, T. 10 N., R. 1 E.:

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores and common medium pores; slightly acid; clear, wavy boundary.
- B1—8 to 14 inches, brown (7.5YR 5/3) heavy silt loam, dark brown (7.5YR 3/2) when moist; weak, medium, prismatic structure that parts to moderate, medium, angular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine pores and few medium pores; few thin clay films; medium acid; clear, wavy boundary.
- B21t—14 to 26 inches, brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky structure; very hard, firm, sticky and plastic; few fine roots; common fine pores; common thin clay films; slightly acid; abrupt, smooth boundary.
- B22t—26 to 48 inches, brown (7.5YR 5/4) clay, reddish brown (5YR 4/3) when moist; strong, coarse, prismatic structure that parts to strong, coarse, subangular blocky structure; extremely firm, very sticky and very plastic; few fine roots; few fine pores; many thin clay films; slightly acid; clear, smooth boundary.
- B23t—48 to 55 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky structure; very hard, firm, sticky and plastic; common fine pores; many moderately thick clay films; neutral; clear, smooth boundary.
- IIC—55 to 70 inches, brown (10YR 5/3) clay loam, dark brown to brown (10YR 4/3) when moist; massive; slightly hard, firm, slightly sticky and plastic; slightly calcareous; mildly alkaline.

The A horizon ranges from dark grayish brown to brown in a hue of 10YR or 7.5YR. Texture ranges from silt loam to light silty clay loam. Reaction ranges from medium acid to neutral. Thickness ranges from 3 to 10 inches. The B1 horizon ranges from brown to dark grayish brown in a hue of 7.5YR or 10YR. Texture ranges from heavy silt loam to silty clay loam. Reaction ranges from medium acid to neutral. Thickness ranges from 4 to 8 inches. The B2t horizon ranges from brown to reddish brown or light brown in a hue of 7.5YR or 5YR. Texture ranges from heavy clay loam or heavy silty clay loam to clay or silty clay. Reaction is slightly acid to neutral. Thickness ranges from 30 to 50 inches. The C horizon ranges from brown to yellowish brown or light brown in hues of 7.5YR and 10YR. Texture ranges from clay loam to light clay. Reaction is neutral to mildly alkaline, and the horizon is slightly calcareous to moderately calcareous.

Included in mapping were small areas of Hendricks silt loam, 10 to 20 percent slopes, and small areas of Sterling gravelly loam, 10 to 20 percent slopes. Also included were small areas of soils that have slopes of 25 to 30 percent.

This soil is fairly easy to till. Permeability is moderately slow. Runoff is medium, and the hazard of erosion is moderate. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Plant roots penetrate to a depth of 5 feet or more.

This soil is used mostly for dryfarmed crops. Principal crops are alfalfa and winter wheat. (Capability unit IVE—

M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Nebeker silt loam, 3 to 6 percent slopes (NbB).—This soil is on the lower part of old alluvial fans. Except for its more gentle slopes, it is similar to Nebeker silt loam, 10 to 25 percent slopes. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mostly for dryfarmed crops, but some areas are irrigated. The crops are small grain and alfalfa. (Capability unit IIe-2, irrigated, IIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Nebeker silt loam, 6 to 10 percent slopes (NbC).—This soil is on fans. Except that it is less sloping, it is similar to Nebeker silt loam, 10 to 25 percent slopes. Runoff is medium, and the hazard of erosion is moderate.

Included in mapping were small areas of Sterling gravelly loam, 6 to 10 percent slopes, and a few small areas of soils that have slopes of 10 to 20 percent.

This soil is used mostly for dryfarmed crops, but some areas are irrigated. Principal crops are alfalfa and small grain. (Capability unit IIIe-2, irrigated, IIIe-M, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 3)

Nibley Series

The Nibley series consists of somewhat poorly drained soils that formed in mixed lake sediment derived from limestone, sandstone, and quartzite. These soils are on medium and low lake terraces at elevations of 4,450 to 4,700 feet. Slopes range from 0 to 6 percent. The vegetation is foxtail, saltgrass, Kentucky bluegrass, wiregrass, and sedges. The average annual precipitation ranges from 14 to 17 inches, the mean annual air temperature is 45° to 47° F., and the frost-free season is 120 to 150 days. Nibley soils are associated with Collett, Greenson, Airport, and Parleys soils.

In a representative profile, the surface layer is dark grayish-brown, mildly alkaline heavy silty clay loam about 13 inches thick. The subsoil is brown and light-gray, mildly alkaline to moderately alkaline silty clay in the upper part and light-gray, strongly alkaline silty clay in the lower part. It is about 30 inches thick. The substratum is light-gray, moderately to strongly alkaline, strongly calcareous silty clay to a depth of 60 inches or more.

Nibley soils are used for irrigated crops and range.

Nibley silty clay loam, 0 to 3 percent slopes (NcA).—This soil is on broad, low lake terraces, generally east of College Ward and north of Hyrum.

Representative profile in a cultivated area, 1/8 mile south and 5/8 mile east of the Utah State University Animal Husbandry Farm Headquarters, 500 feet north and 300 feet east of the southwest corner of the northeast quarter of sec. 30, T. 11 N., R. 1 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure; hard, firm, sticky and plastic; common fine roots and few medium roots; few fine pores; noncalcareous; mildly alkaline; abrupt, smooth boundary.

A1—7 to 13 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; hard,

firm, sticky and plastic; common fine roots and few medium roots; common fine pores; noncalcareous; mildly alkaline; abrupt, smooth boundary.

B21t—13 to 20 inches, brown (10YR 5/3) silty clay, brown to dark brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; very hard, very firm, sticky and very plastic; common fine roots; common fine pores and few medium pores; common thin clay films; slightly calcareous; mildly alkaline; gradual, wavy boundary.

B22tca—20 to 32 inches, light-gray (10YR 7/2) silty clay, grayish brown (10YR 5/2) when moist; few, fine, distinct, strong brown (7.5YR 5/8) mottles; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky structure; very hard, very firm, sticky and very plastic; few fine roots; many fine pores and few medium pores; few thin clay films; strongly calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—32 to 43 inches, light-gray (10YR 7/2) silty clay, pale brown (10YR 6/3) when moist; common, medium distinct, strong-brown (7.5YR 5/8) mottles; weak, medium, prismatic structure that parts to moderate, fine, subangular blocky structure; very hard, very firm, sticky and very plastic; few fine roots; many fine pores and few medium pores; strongly calcareous; strongly alkaline; clear, smooth boundary.

C—43 to 60 inches, light-gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) when moist; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; massive; very hard, very firm, sticky and very plastic; common fine pores; strongly calcareous; moderately alkaline.

The A horizon ranges from dark grayish brown to grayish brown. Texture ranges from silty clay loam to heavy silt loam. Reaction is neutral to mildly alkaline. Thickness ranges from 6 to 15 inches. The B2t horizon ranges from brown to grayish brown in a hue of 10YR or 7.5YR. Texture ranges from heavy silty clay loam to silty clay. Reaction ranges from neutral to moderately alkaline. The B2tca and B3ca horizons range from light gray to light brown or very pale brown in hues of 10YR and 7.5YR. Texture ranges from silty clay to heavy silty clay loam. Reaction is moderately alkaline to strong alkaline. The C horizon ranges from light gray to white or very pale brown in a hue of 2.5Y, 10YR, or 7.5YR. Texture ranges from silt loam to silty clay. Reaction is moderately alkaline to strongly alkaline. The depth to the water table generally is 30 to 40 inches in undrained areas and is 50 inches to more than 60 inches in drained areas.

The soil is fairly difficult to till. Permeability is slow. Runoff is very slow to slow, and the hazard of erosion is none to slight. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Most plant roots are within a depth of 20 inches, but some penetrate to a depth of more than 5 feet.

Included in mapping were small areas of soils that are slightly affected by salt and alkali. Also included are a few small areas of Greenson loam, 0 to 3 percent slopes, and Collett silty clay loam.

This soil is mostly drained. It is used mainly for irrigated crops of alfalfa, small grain (fig. 9), sugar beets, and corn for silage. Some areas are in native pasture. (Capability unit IIIw-2, irrigated; Semiwet Meadow range site; not in a woodland suitability group; wildlife suitability group 1)

Nibley silty clay loam, 3 to 6 percent slopes (NcB).—This soil is in narrow bands and generally is at slightly higher elevations than Nibley silty clay loam, 0 to 3 percent slopes. Slopes are short. Runoff is slow to medium, and the hazard of erosion is slight to moderate.



Figure 9.—Barley growing on Nibley silty clay loam, 0 to 3 percent slopes. Wasatch Mountains are in the background.

Included in mapping were small areas of gravelly loam soils and small areas of Greenson loam, 3 to 6 percent slopes.

This soil is used for irrigated crops of alfalfa, small grain, and sugar beets. (Capability unit IIIw-2, irrigated; not in a range site or a woodland suitability group; wildlife suitability group 1)

Obray Series

The Obray series consists of well-drained soils that formed in mixed colluvium and alluvium derived from limestone, quartzite, and sandstone. These soils are on alluvial and colluvial fans at elevations of 5,000 to 7,000 feet. Slopes range from 1 to 20 percent. The vegetation is Idaho fescue, slender wheatgrass, prairie junegrass, Great Basin wildrye, mulesear dock, yarrow, low sagebrush, and snowberry. The average annual precipitation ranges from 18 to 25 inches, the mean annual air temperature is 42° to 45° F., and the frost-free season is 60 to 100 days. Obray soils are associated with Nebeker, Goring, Hiibner, and Yeates Hollow soils.

In a representative profile, the soil is dark grayish-brown to pale-brown, slightly acid to mildly alkaline silty clay that extends to a depth of 60 inches or more.

Obray soils are used mostly as range. Some small areas are used for dryfarmed crops of alfalfa and small grain.

Obray silty clay, 1 to 6 percent slopes (ObB).—This soil is on the foot slopes of mountains in an area south of East Canyon and southeast of the town of Avon.

Representative profile in a cultivated area, about 4 miles south and 1 mile east of Avon, 900 feet west of the southeast corner of the northwest quarter of sec. 25, T. 9 N., R. 1 E.:

- Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine and medium, granular structure; very hard, firm, sticky and very plastic; few medium and fine roots; common fine pores; slightly acid; clear, smooth boundary.
- A11—7 to 22 inches, brown to dark-brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium and fine, angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common slickensides; slightly acid; gradual, wavy boundary.
- A12—22 to 32 inches, brown (7.5YR 5/3) silty clay, dark brown (7.5YR 3/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common slickensides; neutral; clear, irregular boundary.
- C1—32 to 39 inches, brown (7.5YR 5/4) silty clay, dark brown (7.5YR 3/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium,

angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common slickensides; slightly calcareous; neutral; gradual, irregular boundary.

C2ca—39 to 52 inches, brown (7.5YR 5/4) silty clay, brown (7.5YR 5/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, angular blocky structure; very hard, very firm, sticky and very plastic; moderately calcareous; mildly alkaline; gradual, irregular boundary.

C3ca—52 to 60 inches, very pale brown (10YR 7/3) heavy silty clay loam, light yellowish brown (10YR 6/4) when moist; massive; hard, firm, sticky and plastic; strongly calcareous; mildly alkaline.

The A horizon ranges from dark grayish brown to brown or dark brown. Reaction is slightly acid to medium acid. Slickensides are common to many. The C horizon ranges from brown to light brown or very pale brown. Texture ranges from silty clay or clay, to heavy silty clay loam or clay loam. Reaction ranges from medium acid to mildly alkaline, and the horizon is noncalcareous to strongly calcareous. The upper 30 inches of the profile is noncalcareous, but at depths between 30 to 65 inches, it ranges from noncalcareous to moderately calcareous. If the soils are dry, cracks $\frac{1}{2}$ inch to 2 inches wide extend to a depth of 40 inches or more. In uncultivated areas, gilgai microrelief is evident.

Permeability is very slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil holds 9 to 11 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 3 to 4 feet.

Included in mapping were small areas of stony silty clay soils on steep escarpments.

This soil is used for range. (Capability unit VIe-M5, nonirrigated; Mountain Clay range site; not in a woodland suitability group; wildlife suitability group 3)

Parleys Series

The Parleys series consists of well-drained soils that have a clay loam subsoil. These soils formed in mixed lake sediment derived from limestone, sandstone, and quartzite. They are on medium and high lake terraces at elevations of 4,500 to 5,100 feet. Slopes range from 0 to 10 percent. The vegetation is bluebunch wheatgrass, big sagebrush, gumweed, and balsamroot. The average annual precipitation ranges from 15 to 17 inches, the mean annual air temperature is 46° to 49° F., and the frost-free season is 120 to 160 days. Parleys soils are associated with Timpanogos, McMurdie, Battle Creek, and Hillfield soils.

In a representative profile, the surface layer is dark grayish-brown, neutral silt loam about 8 inches thick. The subsoil is neutral, dark grayish-brown loam, brown clay loam, and pale-brown silt loam about 28 inches thick. The substratum is light-brown, mildly alkaline, strongly calcareous silt loam to a depth of 60 inches or more.

Parleys soils are used for dryfarmed and irrigated crops.

Parleys silt loam, 0 to 3 percent slopes (PaA).—This level to slightly undulating soil is on slightly convex, medium and high lake terraces.

Representative profile in a cultivated area, $1\frac{1}{2}$ miles south and $1\frac{3}{4}$ miles east of the city of Hyrum, 100 feet north and 900 feet west of the southeast corner of the northeast quarter of sec. 15, T. 10 N., R. 1 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate,

fine and medium, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; neutral; abrupt, smooth boundary.

B1—8 to 12 inches, dark grayish-brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, angular blocky structure; very hard, firm, slightly sticky and plastic; common fine roots; common fine pores; thin patchy clay films, neutral; clear, wavy boundary.

B21t—12 to 19 inches, brown (7.5YR 5/4) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky structure; very hard, firm, slightly sticky and plastic; common fine roots; many fine pores; thin continuous clay films; neutral; distinct, smooth boundary.

B22t—19 to 31 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; many fine pores; thin continuous clay films; neutral; distinct, smooth boundary.

B3ca—31 to 36 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores and few medium pores; strongly calcareous; mildly alkaline; clear, smooth boundary.

C1ca—36 to 52 inches, light-brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine pores; strongly calcareous; mildly alkaline.

C2ca—52 to 68 inches, light-brown (7.5YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; few, medium, faint, strong-brown (7.5YR 5/6) mottles; massive; soft, very friable, slightly sticky and slightly plastic; strongly calcareous; mildly alkaline.

The A horizon ranges from dark grayish brown to grayish brown. Texture ranges from silt loam to loam or light silty clay loam. Reaction is neutral to mildly alkaline. Thickness ranges from 7 to 18 inches. The B2t horizon ranges from brown to yellowish brown in a hue of 10YR or 7.5YR. Texture is silty clay loam to clay loam. The Cca and C horizons range from light brown to very pale brown or pale brown in a hue of 10YR or 7.5YR. Texture ranges from silt loam or loam to silty clay loam. Reaction is mildly alkaline to moderately alkaline.

This soil is easy to till. Permeability is moderately slow. Runoff is slow, and the hazard of erosion is none to slight. This soil holds 10 to 12 inches of available water to a depth of 5 feet. Roots penetrate to a depth of 4 feet or more.

Included in mapping were small areas of Timpanogos silt loam, 0 to 3 percent slopes, and small areas of moderately well drained Parleys soils.

This soil is used for irrigated crops. Principal crops are alfalfa, small grain, sugar beets, peas, beans, and corn for silage. About 20 percent of the acreage is used for dryfarmed crops of alfalfa and small grain. (Capability unit IIc-2, irrigated, IIIe-U, nonirrigated; not in a range site or a woodland suitability group; wildlife suitability group 2)

Parleys silt loam, 3 to 6 percent slopes (PaB).—This soil generally is on high lake terraces along the east side of Cache Valley, extending from Smithfield south to Paradise. Except for slope, it is similar to Parleys silt loam, 0 to 3 percent slopes. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in mapping were small areas of Hillfield silt loam, 20 to 30 percent slopes, eroded.

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