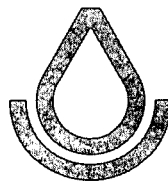


**SOIL SURVEY OF**

# **Minidoka Area, Idaho**

**Parts of Minidoka, Blaine, and Lincoln Counties**



**United States Department of Agriculture**  
**Soil Conservation Service**  
In cooperation with  
**University of Idaho College of Agriculture**  
**Idaho Agricultural Experiment Station**

**Issued January 1975**

Major fieldwork for this soil survey was done in the period 1963-68. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1968. This survey was made cooperatively by the Soil Conservation Service, the University of Idaho College of Agriculture, and the Idaho Agricultural Experiment Station. It is part of the technical assistance furnished to the Minidoka and Wood River Soil and Water Conservation Districts and Blaine Soil Conservation District.

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

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

### Locating Soils

All the soils of the Minidoka Area, parts of Minidoka, Blaine, and Lincoln Counties, 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 survey area in alphabetic order by map symbol and gives the irrigated and nonirrigated capability classification of each. It also shows the page where each soil is described and the page for the capability unit and windbreak group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation 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 and the windbreak groups.

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

*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 Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties*, 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 survey area given in the section "General Nature of the Area."

**Cover:** Good stand of wheat (Gaines variety) in a field northwest of Rupert. The soil is Paulville fine sandy loam.

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# SOIL SURVEY OF MINIDOKA AREA, IDAHO, PARTS OF MINIDOKA, BLAINE, AND LINCOLN COUNTIES

BY HAROLD L. HANSEN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE  
UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE AND THE IDAHO AGRICULTURAL EXPERIMENT STATION

**T**HE MINIDOKA AREA, parts of Minidoka, Blaine, and Lincoln Counties (called the Minidoka Area in this survey) covers 319,940 acres, or about 500 square miles (fig. 1). Of this, 266,140 acres is the southern part of Minidoka County, 33,800 acres is in the southeastern tip of Blaine County, and 20,000 acres is in the southeastern corner of Lincoln County. The survey area is bounded on the south by Walcott Lake and the Snake River. About 212,640 acres is irrigated, and the rest is dry pasture and range.

The survey area is in the Snake River Plain section of the Columbia Plateau province (4).<sup>1</sup> The topography ranges from nearly level, very low terraces adjacent to the Snake River to a very gently undulating, loess-covered basalt upland in the northern part of the survey area. The elevation ranges from about 4,125 feet at the Snake River to 5,000 feet on Kimama Butte, which is the highest point and is about at the center of the western edge of the survey area.

## How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Minidoka Area, where they are located, and how they can be used. The soil scientists went into the survey area knowing they were likely to 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 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 counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil*

*phase* are the categories of soil classification most used in a local survey.

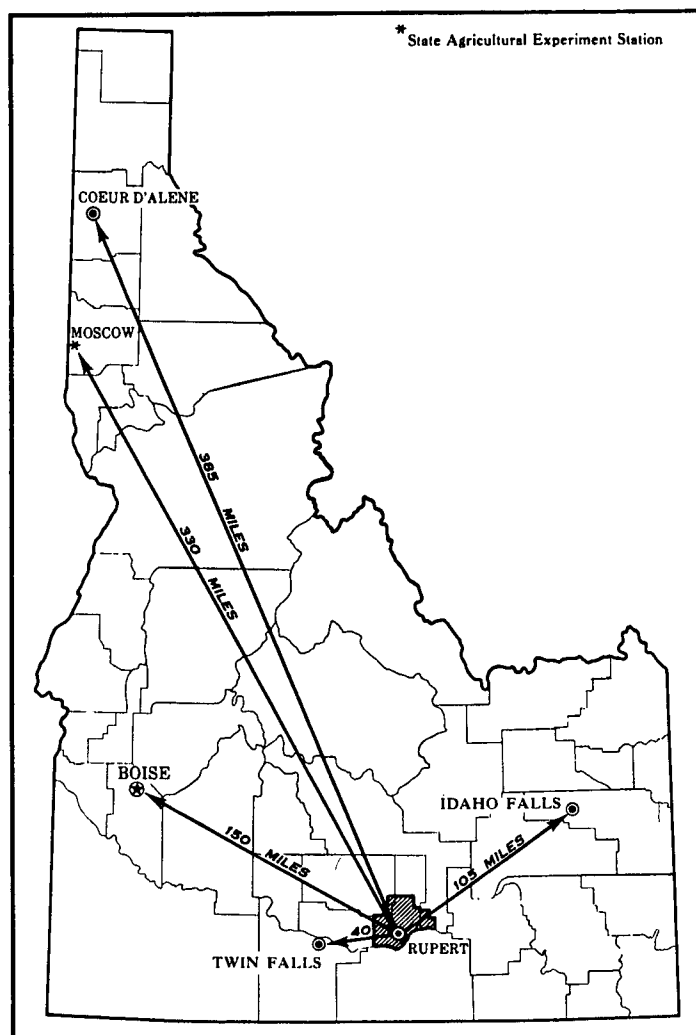


Figure 1.—Location of the Minidoka Area in Idaho.

<sup>1</sup> Italic numbers in parentheses refer to Literature Cited, page 71.

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 geographical feature near the place where a soil of that series was first observed and mapped. Minidoka and Portneuf, for example, are the names of two soil series. All the soils in the United States that have 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 layer 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, Minidoka silt loam, 0 to 2 percent slopes, is one of four phases within the Minidoka 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 buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The kind of use anticipated for soils determines the amount of detail that is shown on the soil map. Where large tracts of soils in the Minidoka Area are used for irrigated crops, the soil scientist drew a line on the map between two kinds of soils that have properties that affect their use for irrigation, such as slight differences in percent of slope, salt content, depth, or permeability. These properties influence the choice of irrigation system, suitability for leveling, suitability for crops, management of water, or other measures important to irrigation. This kind of soil survey is called a high-intensity survey. Portneuf silt loam, 0 to 2 percent slopes, is an example of a mapping unit for the high-intensity surveys in the Minidoka Area. Nearly all the survey area is high intensity, except for a small area of low intensity immediately north of Lake Walcott and other odd corners in the northern part.

Where soils are used for range, the soil boundaries encompass either more than one named soil in a complex or an undifferentiated group, or more than one phase of a named soil. Slight differences in soil properties, such as slope or salinity, are not so important on range as on irrigated soils. Thus, the range of properties within a mapping unit is much greater if the soil survey is for range than if it is for irrigated soils. Portneuf-Trevino complex, 2 to 20 percent slopes, is an example of a mapping unit in an area of range.

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 Minidoka Area: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed 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. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Portneuf-Trevino complex, 2 to 20 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. Vining and Somsen soils and Rock outcrop, 2 to 20 percent slopes, is an undifferentiated soil group in this survey area.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been 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. Rock land is a land type in this survey area.

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

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They 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 current 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 Minidoka Area, parts of Minidoka, Blaine, and Lincoln Counties. 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 a survey area, who want to compare different parts of a survey 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, an area of range, 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 soil associations in this survey have been grouped into five general kinds of landscape for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of the first broad grouping, the words "silt loams" refer to the texture of the surface layer of the major soils.

### Level to Strongly Sloping, Well-Drained Silt Loams on Basalt Plains

These soils formed in wind-deposited silt that overlies the irregular topography of basalt lava flows. They are mainly moderately deep to deep, but some soils are shallow and Rock outcrop occurs. These soils are mainly in the northern and western parts of the survey area. Elevations range from about 4,200 to 4,700 feet, and the average annual precipitation is about 8 to 11 inches. Average annual temperature is about 48° F., and the frost-free season averages about 120 to 130 days.

About 75 percent of the acreage is used for irrigated crops and pasture. The rest is used for range or wildlife or is idle.

The four soil associations in this group make up about 66 percent of the Minidoka Area.

#### 1. Portneuf-Portino-Trevino association

*Level to strongly sloping, very deep to shallow soils*

This association consists of level and nearly level to strongly sloping, well-drained soils that formed in wind-laid silt deposits. The topography is extremely irregular because of the underlying basalt lava flows. Elevation is 4,200 to 4,700 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 120 to 130 days.

The association occupies approximately 15 percent of the survey area. It is about 50 percent Portneuf soils, 20 percent Portino soils, and 15 percent Trevino soils. Minor soils of the Kimama, Minidoka, and Wheeler series, the clayey subsoil variant of the Paulville series, and Rock land make up about 15 percent.

Portneuf, Portino, and Trevino soils occur throughout the association, but the Portneuf soils are most extensive in the southeastern part. Portino soils are associated with Trevino soils. Minidoka soils are in the northern part of the association, and the other minor soils are scattered throughout.

Portneuf soils typically have a surface layer of pale-brown silt loam about 9 inches thick. The subsoil is pale-brown silt loam 4 inches thick. The upper part of the substratum is white and light-gray, slightly hard silt loam to a depth of 42 inches. The lower part is very pale brown, soft silt loam that extends to a depth of 64 inches. The profile is limy throughout.

Portino soils typically have a surface layer of light brownish-gray silt loam about 4 inches thick. The subsoil is pale-brown silt loam that extends to a depth of 13 inches. The substratum is light-gray and white loam. Bedrock is at a depth of about 28 inches. The profile is limy below a depth of 13 inches and has angular pebbles and cobblestones throughout.

The Trevino soils are shallow. Typically they have a surface layer of pale-brown silt loam about 3 inches thick. The subsoil is pale-brown silt loam about 8 inches thick. The substratum is stony loam. Basalt bedrock is at a depth of 15 inches. The profile is limy and has about 20 percent basalt fragments below a depth of 11 inches.

About 50 percent of this association is used for irrigated crops or pasture. The rest is too rocky to be used for intensive cultivation, and no wells have been drilled in the area. The main crops are potatoes, sugar beets, wheat, barley, hay, and irrigated pasture.

Chinese pheasants and gray partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in areas of big sagebrush.

#### 2. Minidoka-Portneuf association

*Level to sloping soils that are moderately deep to indurated hardpan and soils that are deep and very deep*

This association consists of level to sloping, well-drained soils that formed in wind-laid silt deposits. The topography is irregular because of the underlying basalt lava flows. Elevation is 4,200 to 4,400 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 125 days.

The association occupies approximately 23 percent of the survey area. It is about 60 percent Minidoka soils and 30 percent Portneuf soils. Minor soils of the Kimama, and Trevino series, the clayey subsoil variant of the Paulville series, and Rock land make up about 10 percent.

Both Minidoka and Portneuf soils occur throughout the association, but the Portneuf soils are most extensive in the central part. The minor soils are in areas scattered throughout.

Minidoka soils typically have a surface layer of light brownish-gray silt loam about 10 inches thick. The underlying layer is light-gray and white silt loam that extends to a depth of 24 inches, and below this is an indurated hardpan cemented with lime and silica. The profile is limy throughout.

Portneuf soils typically have a surface layer of pale-brown silt loam about 9 inches thick. The subsoil is pale-brown silt loam 4 inches thick. The upper part of the substratum is white and light-gray, slightly hard silt loam that reaches to a depth of 42 inches. The lower part of the substratum is very pale brown, soft silt loam that extends to a depth of 64 inches. The profile is limy throughout.

About 70 percent of this association is used for irrigated crops or pasture. The rest is used for range or is idle. Some of this acreage is too rocky or stony to be used for crops, and no wells have been drilled in the area. The common crops are potatoes, sugar beets, wheat, barley, peas, corn for silage, beans, hay, and irrigated pasture.

Chinese pheasants and gray partridge are the principal upland game birds. They feed along fence rows and in fields and find protective cover along fence rows, in odd corners, and in areas of big sagebrush. Antelope feed in areas of big sagebrush and along fringes of cultivated land.

### **3. Portneuf association**

*Level to sloping, deep and very deep soils*

This association consists of level and nearly level or gently sloping soils that formed in loess on a basalt plain. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is about 48° F., and the length of the frost-free season is 120 to 130 days.

The association occupies approximately 24 percent of the survey area. It is about 80 percent Portneuf soils. Minor soils of the Kimama, Trevino, and Portino series and Rock land make up about 20 percent.

Portneuf soils occur throughout the association. Kimama soils are in small scattered areas throughout the association. Trevino and Portino soils occur mainly along the western and eastern edges of the association.

Portneuf soils typically have a surface layer of pale-brown silt loam about 9 inches thick. The subsoil is pale-brown silt loam 4 inches thick. The upper part of the substratum is white and light-gray, slightly hard silt loam that extends to a depth of 42 inches. The lower part is very pale brown, soft silt loam that extends to a depth of 64 inches. The profile is limy throughout. In some areas an indurated hardpan or bedrock is at a depth of as little as 40 inches.

About 95 percent of this association is used for irrigated crops or pasture. The rest is used for range or is idle. Some of this acreage is too shallow and rocky to cultivate, and some is odd corners. The common crops are sugar beets, potatoes, beans, peas, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants and a few gray partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in areas of big sagebrush.

### **4. Portino-Portneuf association**

*Level to sloping, moderately deep to very deep soils*

This association consists of level and nearly level to sloping and gently undulating, well-drained soils that formed in wind-laid silty deposits. The topography is extremely irregular because of the underlying basalt lava flows. Elevation is about 4,300 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is about 48° F., and the length of the frost-free season is 125 days.

The association occupies approximately 4 percent of the survey area. It is about 55 percent Portino soils and 35 percent Portneuf soils. Minor soils of the Kimama, Minidoka, and Trevino series and Rock land make up about 10 percent. All the soils and Rock land are intermingled throughout the association.

Portino soils typically have a surface layer of light brownish-gray silt loam about 4 inches thick. The subsoil is pale-brown silt loam that extends to a depth of 13 inches. The substratum is light-gray and white loam. Bedrock is at a depth of about 28 inches. The profile is limy below a depth of 13 inches and has angular pebbles and cobblestones throughout.

Portneuf soils typically have a surface layer of pale-brown silt loam about 9 inches thick. The subsoil is pale-brown silt loam 4 inches thick. The upper part of the substratum is white and light-gray, slightly hard silt loam. The lower part is very pale brown, soft silt loam that extends to a depth of 64 inches. The profile is limy throughout.

About 33 percent of this association is used for irrigated crops or pasture. The rest is used for dry pasture or range. The common crops are potatoes, sugar beets, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants and gray partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in areas of big sagebrush. A few antelope feed in areas of big sagebrush and along the fringes of cultivated fields.

### **Very Gently Sloping to Strongly Sloping, Well-Drained Silt Loams on Basalt Plains**

These soils formed in shallow and moderately deep, wind-deposited silt that overlies irregular basalt flows. Areas of Rock outcrop are interspersed. These soils are along the northeastern edge of the survey area. Elevation is about 4,300 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the frost-free season is about 125 days.

The acreage is either used for range or is idle.

The only soil association in this group occupies about 3 percent of the survey area.

### **5. Trevino-Portino association**

*Dominantly shallow and moderately deep soils interspersed with rock outcrops*

This association consists of nearly level to strongly sloping, well-drained soils that formed in loess deposits

of variable thickness. The topography is extremely irregular because of the underlying basalt lava flows. Potholes, basins, and intermittent drainageways that do not have outlets are common. Elevation is about 4,300 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 125 days.

This association occupies approximately 3 percent of the survey area. It is about 40 percent Trevino soils, 30 percent Portino soils, and 10 percent Portneuf soils. Minor soils of the Kimama series and Rock outcrop make up about 20 percent.

Trevino soils are associated with small to large rock outcrops. They typically have a surface layer of pale-brown silt loam about 3 inches thick. The subsoil is pale-brown silt loam about 8 inches thick. The substratum is stony loam. Basalt bedrock is at a depth of 15 inches. The profile is limy and has about 20 percent basalt fragments below a depth of 11 inches.

Portino soils typically have a surface layer of light brownish-gray silt loam about 4 inches thick. The subsoil is pale-brown silt loam that extends to a depth of 13 inches. The substratum is light-gray and white loam. Bedrock is at a depth of about 28 inches. The profile is limy below a depth of 13 inches and has angular pebbles and cobblestones throughout.

This association is used for range or is idle.

Antelope feed in areas of big sagebrush and along the fringes of the adjacent cultivated fields.

## **Level to Strongly Sloping, Well-Drained Sands and Fine Sandy Loams on Basalt Plains**

These soils formed in wind-laid sandy deposits that overlie the irregular topography of basalt flows. They are mainly moderately deep to deep, but there are areas of Rock outcrop. These soils are in the southeastern corner of the survey area. Elevation is about 4,200 feet, and average annual precipitation is 8 to 10 inches. Average annual temperature is about 48° F., and the frost-free season is about 130 days.

About 20 percent of the acreage is used for irrigated crops and pasture. The rest is used for range and wildlife habitat.

### **6. Somsen-Vining association**

*Moderately deep fine sandy loams interspersed with rock outcrops*

This association consists of nearly level to strongly sloping soils associated with outcrops of bedrock. The topography is irregular because of the underlying basalt lava flows. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is 130 days.

This association occupies approximately 5 percent of the survey area. It is about 40 percent Somsen soils and 20 percent Vining soils. Minor soils of the Kecko, Feltham, Taunton, Escalante, and Quincy series and Rock outcrop make up about 40 percent. All the soils are intermingled throughout the association.

Somsen soils typically have a surface layer of grayish-brown and light brownish-gray very stony fine sandy loam about 4 inches thick. The subsoil is light brownish-gray very stony fine sandy loam about 5 inches thick. The substratum is light brownish-gray and white very stony fine sandy loam. Basalt bedrock is at a depth of 24 inches. The profile is limy, except for the upper 1½ inches.

Vining soils typically have a surface layer of light brownish-gray very stony fine sandy loam about 4 inches thick. The subsoil is brown very stony fine sandy loam that extends to a depth of 13 inches. The substratum is pale-brown very stony sandy loam. Basalt bedrock is at a depth of 27 inches and is coated with lime on the surface and in the cracks.

This association is used mainly for range and wildlife habitat.

Pheasants, chukar partridge, and ducks are the principal upland game birds. Ducks feed near the lake and river and in some nearby fields. Pheasants feed in nearby fields and along fence rows. A few antelope feed on scattered native browse and grass and along the fringes of cultivated fields.

### **7. Vining-Escalante-Quincy association**

*Moderately deep to very deep fine sandy loams and sands*

This association consists of level to sloping soils of variable depths. The topography is extremely irregular because of the underlying basalt lava flows. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 130 days.

The association occupies about 3 percent of the survey area. It is about 30 percent Vining soils, 30 percent Escalante soils, and 10 percent Quincy soils. Minor soils of the Feltham, Taunton, Kecko, Kimama, Paulville, and Somsen series and the clayey subsoil variant of the Paulville series make up about 30 percent.

Vining soils occur throughout the association. Quincy soils are mainly in the eastern two-thirds of the association. Escalante soils occur in the north-central part. Feltham and Kecko soils are in the western end and also in the central part. Taunton and Paulville soils and the clayey subsoil variant of the Paulville series are in the central part. Kimama soils occur in the west-central part, and Somsen soils, in the central and northeastern parts.

Vining soils typically have a surface layer of light brownish-gray very stony fine sandy loam about 4 inches thick. The subsoil is brown very stony fine sandy loam that extends to a depth of 13 inches. The substratum is pale-brown very stony sandy loam. Basalt bedrock is at a depth of 27 inches and is coated with lime on the surface and in the cracks.

Escalante soils typically have a surface layer of light brownish-gray and pale-brown loamy fine sand and fine sandy loam about 7 inches thick. The subsoil is pale-brown fine sandy loam about 5 inches thick. The upper part of the substratum is light-gray and very pale brown fine sandy loam that extends to a depth of 44 inches. The lower part is very pale brown loamy fine sand to a depth of 50 inches and more.

Quincy soils typically are light brownish-gray sand to a depth of 64 inches. The underlying material is pale-brown sand.

About 50 percent of this association is used for irrigated crops or pasture. The rest is used for dry pasture or range or is idle. The main crops are potatoes, beans, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in areas of big sagebrush and weeds.

### **Level to Sloping, Well-Drained Sands to Silty Clay Loams on Low Alluvial Terraces**

These soils formed in stratified loamy alluvial deposits and sandy wind deposits. They are mainly deep and very deep. These soils are in the southern part of the survey area, north of Paul and Rupert. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is about 48° F., and the frost-free season averages about 125 to 130 days.

Nearly all the acreage is used for irrigated crops and pasture.

The two soil associations in this association group make up about 12 percent of the Minidoka Area.

#### **8. Paulville-Declo association**

##### *Deep and very deep loams*

This association consists of level to gently sloping soils that formed in stratified, loamy alluvial deposits that have been influenced by wind deposition, particularly in the upper part. Much of the area is underlain by sand. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 125 days.

The association occupies approximately 7 percent of the survey area. It is about 50 percent Paulville soils and 25 percent Declo soils. Minor soils of the Feltham, Kecko, Escalante, Clems, and Quincy series and the clayey subsoil variant of the Paulville series make up about 25 percent.

Both Paulville and Declo soils occur throughout the association. Feltham, Kecko, Clems, and Quincy soils are in the northern and northeastern parts. Escalante soils are in the central and eastern parts, and the clayey subsoil variant of the Paulville series is in the northwestern and western parts.

Paulville soils typically have a surface layer of brown loam about 10 inches thick. The subsoil is brown heavy loam that extends to a depth of 21 inches. The upper part of the substratum is light-gray silt loam that extends to a depth of 35 inches. The lower part is white heavy loam that extends to a depth of 42 inches. Between depths of 42 and 47 inches is light-gray loamy fine sand, and below this is fine sand that extends to a depth of 60 inches. The profile is limy below a depth of 21 inches.

Declo soils typically have a surface layer of light brownish-gray loam about 8 inches thick. The subsoil is

light brownish-gray loam that extends to a depth of 12 inches. The upper part of the substratum is white loam, and the lower part is white and light brownish-gray very fine sandy loam and light loam to a depth of 60 inches. The profile is limy throughout.

About 98 percent of this association is used for irrigated crops or pasture. The rest is odd corners or areas that cannot be irrigated because of topography. The common crops are sugar beets, beans, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows and in odd corners.

#### **9. Tindahay-Quincy association**

##### *Deep and very deep sandy loams to sands*

This association consists of level to sloping soils that formed in alluvium and eolian deposits. It is on low terraces. Elevation is about 4,200 feet, and average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 130 days.

The association occupies approximately 5 percent of the survey area. It is about 65 percent Tindahay soils and 15 percent Quincy soils. Minor soils of the Feltham, Escalante, Declo, Paulville, and Clems series make up about 20 percent.

Tindahay soils occur mainly in the central and southwestern parts of the association. Quincy soils are most common in the northern and eastern parts. Minor soils are somewhat scattered, but are most extensive in the eastern half.

Tindahay soils typically have a surface layer of pale-brown sandy loam about 8 inches thick. The upper part of the underlying material is pale-brown sandy loam that extends to a depth of 23 inches. The lower part is light brownish-gray loamy coarse sand that extends to a depth of 27 inches. Below a depth of 27 inches is light-gray gravelly coarse sand.

Quincy soils typically are light brownish-gray sand to a depth of 64 inches. The underlying material is pale-brown sand.

About 90 percent of this association is used for irrigated crops or pasture. The rest is not irrigated because it is dune and has irregular slopes. The main crops are beans, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants and chukar partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, in areas of big sagebrush, and along the few windbreaks.

### **Level and Nearly Level, Somewhat Poorly Drained Loamy Sands to Clay Loams on Low Alluvial Terraces**

Soils of this group formed in sandy and loamy alluvial deposits. In places, sandy wind deposits cover the alluvium. These soils are very deep but are underlain mainly by sand and gravelly sand. A high water table

is common in the summer. These soils are in the southern part of the survey area, mainly south of Paul and Rupert. Elevation is about 4,200 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the frost-free season averages about 130 days.

Nearly all the acreage is used for irrigated crops and pasture.

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

#### 10. *Schodson-Arloval-Maxey association*

##### *Very deep sandy loams to loamy sands*

This association consists of level or nearly level soils that formed in sandy alluvial deposits on low terraces (fig. 2). Wind-laid material is in the upper part of the profile. The landscape has some slight ridges and depressions, and accumulations of windblown soil material account for some convex surfaces. A high water table is common in summer. Elevation is approximately 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 130 days.

The association occupies about 2 percent of the survey area. It is about 30 percent Schodson soils, 25 percent Arloval soils, and 20 percent Maxey soils. Minor soils of the Decker, Wodskow, Quincy, and Tindahay series make up about 25 percent.

Schodson, Arloval, and Maxey soils occur throughout the association. Decker and Wodskow soils are mainly in the western and southwestern parts, and Quincy and Tindahay soils are mostly in the eastern part.

Schodson soils typically have a surface layer and upper part of the substratum of brown sandy loam about 25 inches thick. The lower part of the substratum is pale-brown loamy coarse sand to a depth of 32 inches and is light brownish-gray and light-gray coarse sand to a depth of 50 inches and more. Mottles occur below a depth of 25 inches. The profile is slightly limy below a depth of 43 inches.

Arloval soils typically have a surface layer of grayish-brown loamy fine sand about 10 inches thick. The underlying material is light brownish-gray loamy fine sand to a depth of 52 inches, and below this it is light brownish-gray light loamy sand. The profile is mottled throughout and has a few spots and veins of lime between depths of 10 and 35 inches.

Maxey soils typically have a surface layer of brown loamy fine sand about 9 inches thick. The upper part of the underlying material is pale-brown loamy fine sand that extends to a depth of 26 inches. The lower part is light-gray to light brownish-gray and white, stratified sandy loam, loam, and loamy sand that extends to a depth of 63 inches. The profile is limy below a depth of 26 inches.

About 90 percent of this association is used for irrigated crops or pasture. The rest is odd corners or low ridges that are higher than the irrigated areas and are covered with big sagebrush or weeds. The main crops are sugar beets, beans, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants and chukar partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in other noncultivated areas. Ducks live and feed along the Snake River, the canals, and the open drainageways and in the adjacent fields.

#### 11. *Wodskow-Decker-Abo association*

##### *Very deep sandy loams to clay loams*

This association consists of level or nearly level soils that formed in stratified, loamy, alluvial deposits on low terraces (fig. 3), but there are also areas of very gently sloping minor soils which occur on the slight ridges and on the slopes to the first bottoms adjacent to the Snake River. A high water table is common in summer. Elevation is about 4,150 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the length of the frost-free season is about 130 days.

The association occupies approximately 9 percent of the survey area. It is about 35 percent Wodskow soils, 30 percent Decker soils, and 10 percent Abo soils. Minor soils of the Arloval, Maxey, and Schodson series and the well-drained Feltham, Declo, and Escalante series make up about 25 percent.

Decker soils occur throughout the association. Wodskow soils occur mainly in the eastern two-thirds of the association, and Abo soils in the western one-third and on the first bottoms adjacent to the Snake River. Arloval, Maxey, and Schodson soils are scattered. The well-drained minor soils occur on the slightly higher areas.

Wodskow soils typically have a surface layer of grayish-brown sandy loam about 12 inches thick. The subsoil is light brownish-gray and pale-brown sandy loam that extends to a depth of 28 inches. The substratum is white loam to a depth of 34 inches, light-gray sandy loam between depths of 34 and 40 inches, and light-gray loamy fine sand between depths of 40 and 55 inches. An unconformable layer of coarse sand is between depths of 55 and 60 inches. The profile is mottled below a depth of 12 inches and is limy, except between depths of 8 and 12 inches.

Decker soils typically have a surface layer of pale-brown loam about 10 inches thick. The subsoil is pale-brown loam that extends to a depth of about 15 inches. The upper part of the substratum is white loam to a depth of 29 inches. The lower part is light-gray, light brownish-gray, and white, stratified sandy loam, light loam, and silt loam that extends to a depth of 65 inches or more. The profile is mottled below a depth of 29 inches and is limy throughout.

Abo soils typically have a surface layer of brown loam about 9 inches thick. The subsoil is brown and pale-brown clay loam that extends to a depth of about 19 inches. The substratum is light-gray and white, calcareous heavy silt loam and loam that extends to a depth of 51 inches, and below this is sand. Mottles occur at a depth of about 34 inches. The profile is limy below a depth of 15 inches.

About 95 percent of this association is used for irrigated crops or pasture. The rest is odd corners or areas of greasewood, big sagebrush, or weeds. The main



**Figure 2.**—Area of the Schodson-Arloval-Maxey association on low terraces southeast of Rupert. White spots in fields are saline. In foreground is the “A” canal; at lower left is a major drainage ditch.

crops are sugar beets, beans, wheat, barley, mixed grain, hay, and irrigated pasture.

Chinese pheasants and chukar partridge are the principal upland game birds. They feed along fence rows and in fields, and they find protective cover along fence rows, in odd corners, and in other idle areas. A few ducks live and feed along the Snake River, the canals, and the open drainageways and in the adjacent fields.

### ***Descriptions of the Soils***

This section describes the soil series and mapping units in the Minidoka Area. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless 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 two descriptions of this profile. The first is brief and in terms familiar to the layman. It is described under the series heading. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described under the first mapping unit in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil, unless otherwise stated.

As mentioned in the section “How This Survey Was Made,” not all mapping units are members of a soil series. Rock land, for example, does not belong to a soil series but, nevertheless, 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 map-



**Figure 3.**—Area of Wodskow-Decker-Abo association that is south and slightly west of Rupert. White spots in field are saline. At right center are drains, marshy spots, and small ponds.

ping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the irrigated and nonirrigated capability units and the windbreak group in which the mapping unit has been placed. The page for the description of each capability unit and windbreak group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (9).

### Abo Series

The Abo series consists of very deep, somewhat poorly drained, level or nearly level soils that formed in

alluvium that is of mixed mineralogy. These soils are on low terraces. Depth to the water table fluctuates between 40 inches and more than 60 inches in summer. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Decker, Paulville, and Wodskow series.

In a representative profile, the surface layer is brown loam about 9 inches thick. The subsoil is brown and pale-brown light clay loam that extends to a depth of about 19 inches. The substratum is light-gray and white, strongly calcareous heavy silt loam and loam that extends to a depth of 51 inches. Below this is sand. Mottles occur at a depth of about 34 inches. The soil is limy throughout below a depth of 19 inches.

Abo soils are used for row crops, hay, and pasture.

**Abo loam** (0 to 2 percent slopes) (Ab).—This soil is in slightly convex areas on low terraces. Slopes are mainly

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Abo sandy loam.....	559	0.2	Portneuf silt loam, 2 to 4 percent slopes.....	37,460	11.7
Abo loam.....	2,622	.8	Portneuf silt loam, 4 to 8 percent slopes.....	7,272	2.3
Abo loam, saline.....	257	.1	Portneuf silt loam, 8 to 12 percent slopes.....	955	.3
Abo clay loam, saline.....	225	.1	Portneuf-Trevino complex, 2 to 20 percent slopes.....	20,152	6.2
Abo clay loam, alkali variant.....	977	.3	Quincy sand, 2 to 12 percent slopes.....	2,004	.6
Arloval loamy fine sand.....	2,188	.7	Quincy loamy sand, 2 to 4 percent slopes.....	667	.2
Arloval sandy loam.....	993	.3	Quincy loamy sand, 4 to 8 percent slopes.....	442	.1
Clems sandy loam.....	821	.3	Quincy-Rock outcrop complex, 2 to 12 percent slopes.....	500	.2
Decker fine sandy loam.....	5,948	1.9	Rock land.....	1,131	.4
Decker fine sandy loam, saline.....	315	.1	Rock outcrop-Trevino complex, 2 to 20 percent slopes.....	2,827	.9
Decker loam.....	2,718	.8	Schodson loamy sand.....	422	.1
Decker loam, saline.....	302	.1	Schodson sandy loam.....	3,673	1.1
Declo fine sandy loam, 0 to 2 percent slopes.....	1,708	.5	Schodson sandy loam, saline.....	273	.1
Declo loam, 0 to 2 percent slopes.....	2,877	.9	Somsen loamy sand, 0 to 4 percent slopes.....	510	.2
Declo loam, 2 to 4 percent slopes.....	949	.3	Somsen loamy sand, 4 to 8 percent slopes.....	364	.1
Declo loam, 4 to 8 percent slopes.....	266	.1	Somsen fine sandy loam, 2 to 4 percent slopes.....	622	.2
Escalante fine sandy loam, 0 to 2 percent slopes.....	1,562	.5	Somsen fine sandy loam, 4 to 8 percent slopes.....	391	.1
Escalante fine sandy loam, 2 to 4 percent slopes.....	1,410	.4	Somsen-Rock outcrop complex, 2 to 20 percent slopes.....	2,031	.6
Escalante fine sandy loam, 4 to 8 percent slopes.....	884	.3	Somsen-Vining complex, 2 to 20 percent slopes.....	4,005	1.3
Feltham loamy sand, 0 to 4 percent slopes.....	1,794	.6	Taunton sandy loam, 2 to 4 percent slopes.....	549	.2
Feltham loamy sand, 4 to 8 percent slopes.....	619	.2	Tindahay loamy sand.....	5,719	1.8
Kecko loamy fine sand, 0 to 4 percent slopes.....	1,648	.5	Tindahay sandy loam.....	6,760	2.1
Kecko fine sandy loam, 0 to 2 percent slopes.....	1,335	.4	Trevino-Portneuf complex, 2 to 20 percent slopes.....	5,536	1.7
Kecko fine sandy loam, 2 to 4 percent slopes.....	542	.2	Trevino-Rock outcrop complex, 2 to 20 percent slopes.....	3,206	1.0
Kimama silt loam.....	13,699	4.2	Vining loamy sand, 0 to 4 percent slopes.....	670	.2
Maxey loamy fine sand.....	1,985	.6	Vining loamy sand, 4 to 8 percent slopes.....	208	.1
Minidoka silt loam, 0 to 2 percent slopes.....	9,109	2.8	Vining fine sandy loam, 2 to 4 percent slopes.....	222	.1
Minidoka silt loam, 2 to 4 percent slopes.....	29,057	9.0	Vining-Quincy complex, 2 to 20 percent slopes.....	524	.2
Minidoka silt loam, 4 to 8 percent slopes.....	8,498	2.7	Vining-Rock outcrop complex, 2 to 20 percent slopes.....	1,882	.6
Minidoka silt loam, 8 to 12 percent slopes.....	335	.1	Vining and Somsen soils and Rock outcrop, 2 to 20 percent slopes.....	5,846	1.9
Paulville loamy fine sand.....	387	.1	Wheeler silt loam, 8 to 12 percent slopes.....	1,395	.4
Paulville fine sandy loam.....	1,970	.6	Wheeler silt loam, 12 to 30 percent slopes.....	1,333	.4
Paulville loam.....	6,183	1.9	Wodskow sandy loam.....	10,265	3.2
Paulville clay loam.....	3,753	1.2	Wodskow sandy loam, saline.....	669	.2
Paulville silt loam, clayey subsoil variant.....	554	.2	Water and other areas.....	4,007	1.3
Paulville silty clay loam, clayey subsoil variant.....	894	.3			
Portino silt loam, 0 to 2 percent slopes.....	2,186	.7			
Portino silt loam, 2 to 4 percent slopes.....	7,695	2.4			
Portino silt loam, 4 to 8 percent slopes.....	5,423	1.7			
Portino silt loam, 8 to 12 percent slopes.....	339	.1			
Portneuf silt loam, 0 to 2 percent slopes.....	59,862	18.7			
			Total.....	319,940	100.0

1 percent or less. The soil areas are elongated to somewhat rounded and 10 to 160 acres in size.

Representative profile, 680 feet north and 580 feet east of the southwest corner of sec. 27, T. 9 S., R. 23 E., 1 mile east of Paul, in a beanfield where the slope is about 0.5 percent.

Ap—0 to 9 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, fine and medium, granular structure; few peds from the B horizon have weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, interstitial pores and common, very fine, tubular pores; mildly alkaline; abrupt, smooth boundary.

B2t—9 to 15 inches, brown (10YR 5/3) light clay loam, pale-brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, tubular pores and few, fine, tubular pores; thin, patchy clay films on ped faces and in pores; in places a few worm-holes 2 to

4 millimeters in diameter are filled with light-gray calcareous material; mildly alkaline; abrupt, wavy boundary.

B3tca—15 to 19 inches, pale-brown (10YR 6/3) light clay loam, dark brown (10YR 4/3) moist; moderate, medium and fine, subangular blocky structure; hard, friable, sticky and plastic; few fine and very fine roots; many, very fine and fine, tubular pores; thin patchy clay films on ped faces and in pores; matrix mostly noncalcareous, but common fine veins and splotches of lime; mildly alkaline; clear, smooth boundary.

C1ca—19 to 24 inches, light-gray (10YR 7/2) heavy silt loam, brown (10YR 5/3) moist; weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; many, very fine, tubular pores and common, fine, tubular pores; few cicada krotovinas; strongly calcareous, common veins and splotches of lime, especially around the krotovinas; mildly alkaline; clear, smooth boundary.

C2ca—24 to 34 inches, light-gray (10YR 7/2) and white (10YR 8/2) heavy loam, brown (10YR 5/3) and light brownish gray (10YR 6/2) moist; very weak, fine and medium, subangular blocky structure; hard,

friable, slightly sticky and slightly plastic; few fine and very fine roots; common, very fine, tubular pores; common cicada krotovinas; strongly calcareous, common veins and splotches of lime; moderately alkaline; clear, smooth boundary.

**C3ca—34** to 45 inches, white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; common, fine and medium, distinct, brown (10YR 5/3) mottles, which are dark yellowish brown (10YR 4/4) moist; moderate, thin and very thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; very few roots; common, very fine, tubular pores; few cicada krotovinas; strongly calcareous, few veins and splotches of lime; moderately alkaline; clear, smooth boundary.

**C4ca—45** to 51 inches, white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; common, fine and medium, distinct, brown (10YR 5/3) mottles, which are dark yellowish brown moist; weak, very thin and thin, platy structure; soft, friable, slightly sticky and slightly plastic; very few roots; common, very fine, tubular pores; few cicada krotovinas; strongly calcareous, few veins and splotches of lime; moderately alkaline; clear, smooth boundary.

**IIC5—51** to 60 inches, sand; few splotches of lime in the upper 2 inches.

The Ap horizon ranges from brown or grayish brown (10YR 5/3 or 10YR 5/2) to pale brown or light brownish gray (10YR 6/3 or 10YR 6/2) in color. The B2t horizon ranges from light clay loam to silty clay loam or sandy clay loam. A layer of lime accumulation has an upper boundary at depths between 12 and 25 inches. Where deep cuts are made by land leveling, the B horizon or upper part of the Cca horizon is exposed in places. Depth to sand or gravelly sand ranges from 40 to 60 inches or more.

Included with this soil in mapping were small areas of saline soils, Abo clay loam, Abo sandy loam, Paulville loam, Decker loam, and a soil that has a mottled, clayey subsoil.

This Abo soil has moderately slow permeability. The available water capacity is 8 to 10 inches. Runoff is slow, and the hazards of water and wind erosion are slight.

This soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, alfalfa hay, and pasture and, in a few places, for barley. Choice of crops is limited somewhat by the high water table during summer. The soil is easily worked throughout a fairly wide range of moisture content. (Capability unit IIw-72, irrigated; windbreak group 76)

**Abo sandy loam** (0 to 2 percent slopes) (Ac).—This soil is similar to Abo loam, except that the surface layer is sandy loam 8 to 14 inches thick and the subsoil is clay loam to heavy sandy clay loam. The hazard of wind erosion is slight. Included in mapping were small areas of Abo loam and Decker fine sandy loam.

This Abo soil is used for sugar beets, barley, wheat, mixed grains, alfalfa hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIw-72, irrigated; windbreak group 76)

**Abo loam, saline** (0 to 2 percent slopes) (Ac).—This soil is similar to Abo loam, except that it contains soluble salts in amounts that impair plant growth. Mapped areas of this soil are smaller than those of Abo loam. Included in mapping were small areas of soils that are saline and have a surface layer of sandy loam.

This soil is used for sugar beets, barley, wheat, mixed grains, alfalfa hay, and pasture. (Capability unit IIIw-64, irrigated; windbreak group 74)

**Abo clay loam, saline** (0 to 2 percent slopes) (Ae).—This soil is similar to Abo loam, except that it contains

soluble salts in amounts that impair plant growth and the surface layer is clay loam. Included in mapping were areas of Abo loam, saline.

This Abo soil is used for sugar beets, barley, wheat, mixed grains, alfalfa hay, and pasture. It can be worked only within a narrow range of moisture content. (Capability unit IIIw-64, irrigated; windbreak group 74)

## Abo Series, Alkali Variant

The Abo series, alkali variant, consists of very deep, somewhat poorly drained, level or nearly level, saline-alkali soils that formed in stratified alluvium that is of mixed mineralogy. These soils are on very low terraces adjacent to the Snake River. Depth to the water table ranges from 35 to 45 inches. In areas that are not cultivated, the vegetation is greasewood, big sagebrush, alkaligrass, and peppergrass. Elevation is 4,125 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated soils are of the Decker and Wodskow series.

In a representative profile, the surface layer is light brownish-gray silt loam or very fine sandy loam about 2 inches thick. The subsoil is gray, light brownish-gray, and white, moderately alkaline, strongly alkaline, and very strongly alkaline clay loam and loam about 11 inches thick. The substratum is stratified light-gray and white, strongly alkaline and very strongly alkaline loamy fine sand, fine sandy loam, and sandy loam. The soil is calcareous below a depth of 5 inches. It is mottled at a depth of 25 inches.

Abo soils, alkali variant, are used mainly for dry pasture. A small acreage is used for irrigated pasture.

**Abo clay loam, alkali variant** (0 to 2 percent slopes) (Ak).—This soil is on very low terraces adjacent to the Snake River. Slopes are irregular because there are slight channels. The soil areas are oval and 180 to 460 acres in size.

Representative profile, 100 feet north and 200 feet west of the southeast corner of the SW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 30, T. 10 S., R. 24 E., 1 $\frac{1}{2}$  miles west of Heyburn in a noncultivated area where the slope is about 0.5 percent.

**A1—0** to 2 inches, light brownish-gray (10YR 6/2) silt loam or very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, platy structure parting to weak, very thin, platy; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many, very fine, interstitial pores; mildly alkaline; abrupt, smooth boundary.

**B21t—2** to 5 inches, gray (10YR 6/1) clay loam, dark gray (10YR 4/1) moist; common bleached grains; weak and moderate, coarse, prismatic structure or weak, coarse, columnar; hard, friable, sticky and plastic; common very fine and fine roots; few, very fine, tubular pores; thin patchy or nearly continuous clay films; moderately alkaline; clear, smooth boundary.

**B22tca—5** to 10 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak and moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; prisms are continuous from B21t through B22tca horizon; hard, friable, sticky and plastic; common very fine roots and few fine roots; thin continuous clay films; slightly calcareous; strongly alkaline; clear, smooth boundary.

B3ca—10 to 16 inches, white (10YR 8/2) loam, light gray (10YR 7/2) moist; very weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; common ½-inch krotovinas filled with material from B2tca horizon; moderately calcareous; very strongly alkaline; clear, smooth boundary.

IIC1ca—16 to 25 inches, light-gray (10YR 7/2) sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; moderately calcareous, common fine veins of lime; very strongly alkaline; clear, smooth boundary.

IIC2ca—25 to 36 inches, light-gray (10YR 7/2) loamy fine sand, grayish brown (10YR 5/2) moist; few, fine, distinct mottles that are dark brown (7.5YR 3/2) moist; many, fine and medium, distinct mottles in lower 3 inches; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots and very few fine and medium roots; moderately calcareous; strongly alkaline; abrupt, smooth boundary.

IIC3ca—36 to 44 inches, white (10YR 8/) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; very few fine roots; moderately calcareous; strongly alkaline; abrupt, smooth boundary.

IIC4ca—44 to 47 inches, light-gray (10YR 7/1) loamy fine sand and thin strata of silt loam and sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable, nonsticky and slightly plastic; very few fine roots; very weakly cemented in part; moderately calcareous; strongly alkaline.

The A1 horizon ranges from grayish brown (10YR 5/2) to light brownish gray (10YR or 2.5Y 6/2) in color. In some areas, it is slightly calcareous. In places reaction ranges as high as very strongly alkaline. The Bt horizon ranges from moderately alkaline to very strongly alkaline. Below a depth of about 16 inches is stratified loam, fine sandy loam, silt loam, loamy fine sand, sandy loam, and loamy sand. Where the soil is plowed or leveled, material in the A horizon has been mixed with material from the upper part of the B horizon and is commonly calcareous.

Included with this soil in mapping were small areas of a poorly drained, dark-colored soil in some narrow drainageways.

This soil is somewhat poorly drained. Permeability is slow in the subsoil and moderately rapid in the substratum. The available water capacity is 7 to 8 inches. Runoff is slow. The hazards of water and wind erosion are none to slight.

This soil is used mainly for dry pasture, but in a few places it is used for irrigated pasture. It can be worked only within a narrow range of moisture content. (Capability unit VIw-54, irrigated; capability unit VIIw-969, nonirrigated; windbreak group 73)

## Arloval Series

The Arloval series consists of very deep, somewhat poorly drained, level and nearly level soils that formed in stratified alluvium that had been influenced by eolian material in the upper part. These soils are of mixed mineralogy but are high in content of quartz. They are on low terraces in slightly lower positions than associated soils. Depth to the water table fluctuates between 20 and 30 inches in summer. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Maxey, Schodson, and Wodskow series.

In a representative profile, the surface layer is grayish-brown loamy fine sand about 10 inches thick. The underlying material is light brownish-gray light loamy sand. The soil is mottled throughout and has a few spots and veins of lime between depths of 10 and 35 inches.

Arloval soils are used for row crops, hay, and pasture.

**Arloval loamy fine sand** (0 to 2 percent slopes) (Ar).—This soil is in slightly concave areas on low terraces. Slopes are mainly less than 1 percent. The soil areas are elongated or somewhat rounded and 5 to 100 acres in size.

Representative profile, 180 feet northwest of the southeast corner of the NE¼NE¼ sec. 8, T. 10 S., R. 24 E., 2¼ miles south of Rupert, in an alfalfa field where the slope is 1 percent.

Ap—0 to 10 inches, grayish-brown (10YR 5/2) loamy fine sand, light brownish gray (10YR 6/2) crushed, dark grayish brown (10YR 3/2) moist, dark grayish brown (10YR 4/2) crushed and moist; few, fine, faint, brown (10YR 5/3) mottles; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots and common medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; mildly alkaline; abrupt, smooth boundary.

C1g—10 to 23 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; common, fine, distinct, strong-brown (7.5YR 5/6) and brown (10YR 5/3) mottles, but dark brown (7.5YR 4/4 and 7.5YR 3/2) and very dark brown (10YR 2/2) moist; very weak, medium, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; in places very slightly calcareous and few fine spots and veins of lime; mildly alkaline; clear, smooth boundary.

C2g—23 to 35 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; many, fine, distinct, brown (7.5YR 4/2) and dark grayish-brown (10YR 4/2) mottles, but dark brown (7.5YR 3/2) and very dark brown (10YR 2/2), respectively, moist; few, fine, prominent, brown (7.5YR 5/4 and 7.5YR 4/3) and reddish-brown (5YR 5/4) mottles, but dark brown (7.5YR 3/3) and reddish brown (5YR 4/4), respectively, moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many, very fine, interstitial pores and common, very fine, tubular pores; very few spots of lime; mildly alkaline; gradual, wavy boundary.

C3g—35 to 52 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles, but yellowish brown (10YR 5/4) moist; few, fine, faint, brown (10YR 5/3) mottles, but dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many, very fine, interstitial pores and common, fine, tubular pores; few fine pebbles; mildly alkaline; gradual, wavy boundary.

C4—52 to 60 inches, light brownish-gray (10YR 6/2) light loamy sand, dark grayish brown (10YR 4/2) moist; few, fine, faint mottles; massive; slightly hard, very friable, nonsticky and nonplastic; many, very fine, interstitial pores and few, very fine, tubular pores; few fine pebbles; mildly alkaline.

The Ap horizon ranges from light brownish gray or grayish brown (10YR 6/2 or 5/2) to pale brown or brown (10YR 6/3 or 5/3) in color. In places the Ap horizon is calcareous because of landleveling operations. Prominent or distinct mottles are above a depth of 20 inches.

Included with this soil in mapping were small areas of Maxey loamy fine sand, Schodson loamy fine sand, soils that are not mottled, and spots of saline soils.

This Arloval soil has rapid permeability. The available water capacity is 5 to 7 inches. Runoff is very slow, the hazard of water erosion is none to slight. The hazard of wind erosion is high.

This soil is used for sugar beets, beans, wheat, mixed grains, corn for silage, alfalfa hay, and pasture and, to some extent, for barley. It can be easily worked throughout a wide range of moisture content. Choice of crops is limited by the high water table in summer. (Capability unit IIw-72, irrigated; windbreak group 76)

**Arloval sandy loam** (0 to 2 percent slopes) (As).—This soil is on low terraces. It is similar to Arloval loamy fine sand, except that it has a surface layer of sandy loam 8 to 10 inches thick. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Schodson sandy loam.

This Arloval soil is used for sugar beets, beans, wheat, mixed grains, corn for silage, alfalfa hay, and pasture and, in a few places, for barley. (Capability unit IIw-72, irrigated; windbreak group 76)

## Clems Series

The Clems series consists of very deep, well-drained, level to nearly level soils that formed in stratified alluvium that was of mixed mineralogy and that had been influenced by eolian sands. These soils are in slightly concave and flat areas on low terraces and along broad drainageways in the basalt uplands. Elevation is 4,150 to 4,200 feet. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Declo, Kecko, Paulville, and Tindahay series.

In a representative profile, the surface layer is brown light sandy loam about 9 inches thick. The subsoil is brown sandy loam that extends to a depth of 35 inches. The substratum is brown sandy loam and loamy sand that extends to a depth of 62 inches. There is no lime in the entire profile.

Clems soils are used for row crops, hay, and pasture.

**Clems sandy loam** (0 to 2 percent slopes) (Ce).—This soil is in concave or flat areas on low terraces and along drainageways on the basalt plains. The soil areas are oblong or somewhat rounded and 10 to 150 acres in size.

Representative profile, 250 feet south and 185 feet west of the northeast corner of the SW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 7, T. 9 S., 24 E., 2.5 miles north and 1 mile west of Rupert.

Ap—0 to 9 inches, brown (10YR 5/3) light sandy loam, dark grayish brown (10YR 4/2) moist; very weak, very fine, granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine, interstitial pores and common, very fine and fine, tubular pores; mildly alkaline; abrupt, smooth boundary.

B1—9 to 14 inches, brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; few, very fine and fine, tubular pores and many, very fine, interstitial pores; mildly alkaline; clear, smooth boundary.

B21—14 to 23 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots and very few medium roots;

many, very fine and fine, tubular pores and many, very fine, interstitial pores; mildly alkaline; clear, smooth boundary.

B22—23 to 35 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many, very fine and fine, tubular pores and many, very fine, interstitial pores; thin patchy clay films on ped surfaces and bridgings between sand grains; mildly alkaline; clear, smooth boundary.

C1—35 to 45 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots; many, very fine, interstitial pores and few, very fine, tubular pores; mildly alkaline; clear, smooth boundary.

IIC2—45 to 62 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few, very fine and fine roots; many, very fine, interstitial pores; mildly alkaline.

The Ap horizon ranges from brown or pale brown (10YR 5/3 or 6/3) to grayish brown or light brownish gray (10YR 5/2 or 6/2) in color. In some places the soil is slightly calcareous. The depth to the IIC horizon ranges from 30 to 60 inches.

Included with this soil in mapping were small areas of Kecko sandy loam and Tindahay sandy loam.

This Clems soil has moderately rapid permeability. The available water capacity is 6 to 8 inches. Runoff is slow. The hazard of wind erosion is slight, and the hazard of water erosion is none to slight.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, alfalfa hay, and pasture. The soil is easily worked throughout a wide range of moisture content. (Capability unit IIC-50, irrigated; windbreak group 71)

## Decker Series

The Decker series consists of very deep, somewhat poorly drained, level and nearly level soils that formed in stratified mixed alluvium on low terraces. In many areas these soils have been influenced by wind deposition. Depth to the water table fluctuates between 30 and 40 inches in summer. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated soils are of the Abo and Wodskow series.

In most places these soils in the Minidoka area average less than 18 percent clay between depths of 10 and 40 inches and are outside the defined range for the series. This difference does not alter their use or behavior.

In a representative profile, the surface layer is pale-brown loam about 10 inches thick. The subsoil is pale-brown loam that extends to a depth of about 15 inches. The upper part of the substratum is white loam to a depth of 29 inches. The lower part is light-gray, light brownish-gray, and white, stratified sandy loam, light loam, fine sand, and silt loam that extends to a depth of 65 inches or more. The profile is mottled below a depth of 29 inches, is slightly gravelly at a depth below 58 inches, and is limy throughout.

Decker soils are used for row crops, hay, and pasture.

**Decker loam** (0 to 2 percent slopes) (De).—This soil is in slightly convex areas on low terraces. The soil areas are long and irregular or somewhat rounded and 5 to 160 acres in size.

Representative profile (fig. 4), 33 feet south and 57 feet east of the northwest corner of SW $\frac{1}{4}$  sec. 34, T. 9 S., R. 23 E., 1 mile south of the Paul sugar factory, in a grainfield where the slope is 0.5 percent.

Ap—0 to 10 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) crushed, dark grayish brown (10YR 4/2) moist; very weak, very fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine, medium, and coarse roots; many, very fine, interstitial pores and common, very fine, tubular pores; few wormholes; slightly calcareous; moderately alkaline; abrupt, smooth boundary.

B—10 to 15 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak, coarse and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; common, very fine, tubular pores and few, fine, tubular pores; soil material from the C1ca horizon fills the wormholes; slightly calcareous, very few veins and spots of lime; moderately alkaline; abrupt, smooth boundary.

C1ca—15 to 23 inches, white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; weak, fine and medium, subangular blocky structure parting to very weak, thin and medium, platy; hard, friable, slightly sticky

and slightly plastic; common very fine and fine roots and few medium roots; common, very fine, tubular pores; strongly calcareous; strongly alkaline; clear, smooth boundary.

C2ca—23 to 29 inches, white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; very weak, medium, subangular blocky structure parting to very weak, thin and medium, platy; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; some roots matted on krotovinas; few, very fine, tubular pores in matrix; about 10 percent firm cicada krotovinas; strongly calcareous, common splotches of lime in matrix and coatings of lime on krotovinas; strongly alkaline; clear, wavy boundary.

IIC3ca—29 to 35 inches, light-gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) moist; few, fine, distinct, dark-brown (7.5YR 3/2 and 4/4) mottles; weak, very thin and thin, platy structure; slightly hard, friable, nonsticky and nonplastic; few very fine roots; many, very fine, tubular pores; few small pockets or lenses of sand; few firm cicada krotovinas; strongly calcareous, few medium veins and fine spots of lime; moderately alkaline; abrupt, smooth boundary.

IIC4—35 to 51 inches, light-gray (10YR 7/2) light loam, grayish brown (10YR 5/2) moist; few, fine, distinct mottles that are dark brown (7.5YR 3/2 and 4/4) moist; weak, very thin and thin, platy structure; slightly hard, friable (upper one-half inch firm), slightly sticky and slightly plastic; few very fine roots; many, very fine, tubular pores; common  $\frac{1}{4}$ - to 1-inch lenses of very fine sand; moderately calcareous; moderately alkaline; abrupt, smooth boundary.

IIC5—51 to 58 inches, light brownish-gray (10YR 6/2) and white (10YR 8/2) stratified fine sand and silt loam, dark grayish brown (10YR 4/2) and brown (10YR 5/3) moist; few fine mottles; fine sand is single grain, silt loam has weak, very thin, platy structure; saturated with water; slightly calcareous; moderately alkaline; abrupt, smooth boundary.

IIIC6—58 to 65 inches, light brownish-gray (10YR 6/2) slightly gravelly sand; few mottles; very slightly calcareous; saturated with water.

The Ap horizon ranges from pale brown or brown (10YR 6/3 or 5/3) to light brownish gray or grayish brown (10YR 6/2 or 5/2) in color. The B horizon is noncalcareous to slightly calcareous. A strong ca horizon has its upper boundary at a depth between 11 and 18 inches.

Included with this soil in mapping were spots where cuts made during leveling exposed the ca horizon; spots of saline soils; and small areas of Abo loam, Decker sandy loam, Declo loam, a soil that is similar to this Decker soil but is less than 40 inches deep to sand, and a soil that has a strong ca horizon at a depth below 18 inches. In some areas the soils have a subsoil and substratum of heavy loam to a depth of 40 inches.

This Decker soil has moderate permeability and is very deep. The available water capacity is 7 to 9 inches. Runoff is slow, and the hazards of wind and water erosion are none to slight.

This soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, alfalfa hay, and pasture and, in a few places, for barley. It can be worked throughout a fairly wide range of moisture content. (Capability unit IIw-72, irrigated; windbreak group 76)

**Decker loam, saline** (0 to 2 percent slopes) (Dk).—This soil is similar to Decker loam, except that it contains soluble salts in amounts that impair plant growth and is in somewhat smaller areas. Included in mapping were small areas of Abo loam, saline.

This Decker soil is used for sugar beets, barley, wheat, mixed grains, alfalfa hay, and pasture. (Capability unit IIIw-64, irrigated; windbreak group 74)

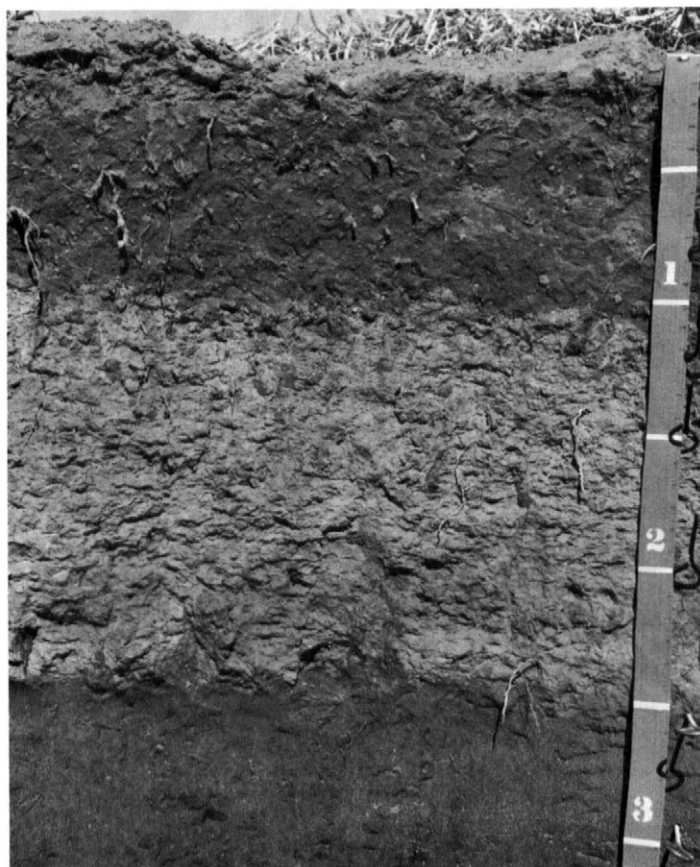


Figure 4.—Profile of Decker loam. A strongly calcareous horizon begins at a depth of about 15 inches, and a horizon of stratified alluvium begins below a depth of 29 inches.

**Decker fine sandy loam** (0 to 2 percent slopes) (Dc).—This soil is similar to Decker loam, except that the surface layer is fine sandy loam 8 to 12 inches thick. Mapped areas are commonly larger than those of Decker loam. The hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Abo sandy loam, Decker loam, and Wodskow sandy loam.

This Decker soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, alfalfa hay, and pasture and, in some places, for barley. It has more wind-deposited sand than the representative soil and can be worked throughout a wide range of moisture content. (Capability unit IIw-72, irrigated; windbreak group 76)

**Decker fine sandy loam, saline** (0 to 2 percent slopes) (Dd).—This soil is similar to Decker loam, except that it has a surface layer of sandy loam 8 to 12 inches thick and is slightly to moderately affected by soluble salts. Mapped areas are smaller than those of Decker loam. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Abo fine sandy loam, saline, and Wodskow fine sandy loam, saline.

This Decker soil is used for sugar beets, wheat, barley, mixed grains, alfalfa hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIIw-64, irrigated; windbreak group 74)

## Declo Series

The Declo series consists of deep and very deep, well-drained, level and nearly level to gently sloping soils that formed in somewhat stratified mixed alluvium and wind-laid material on low terraces and basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, rabbitbrush, bluebunch wheatgrass, and Sandberg bluegrass. Elevation is 4,150 to 4,300 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 47° to 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Paulville and Portneuf series.

In a representative profile, the surface layer is light brownish-gray loam about 8 inches thick. The subsoil is light brownish-gray loam that extends to a depth of 60 inches. The profile is limy throughout.

Declo soils are used for row crops, hay, and pasture.

**Declo loam, 0 to 2 percent slopes** (DmA).—This soil is in slightly convex and level areas on low terraces and the basalt plains. The soil areas are generally somewhat rounded or oblong and 4 to 200 acres in size.

Representative profile, 300 feet north and 530 feet west of the southeast corner of sec. 19, T. 9 S., R. 23 E., 1 mile west and 1 mile north of Paul, in a potato field where the slope is 0.3 percent.

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; very weak, medium, subangular blocky structure parting to very weak, very fine, granular; hard, friable, slightly sticky and slightly plastic; common very fine roots; common wormholes; many, very fine, interstitial pores; slightly calcareous; mildly alkaline; abrupt, smooth boundary.

B—8 to 12 inches, light brownish-gray (10YR 6/2) loam; weak, medium and fine, subangular blocky structure;

slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; common wormholes; common, very fine, tubular pores and few, medium, tubular pores; slightly calcareous to moderately calcareous; mildly alkaline; clear, smooth boundary.

C1ca—12 to 24 inches, white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; weak, medium and fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; few wormholes in upper part; common, very fine, tubular pores; very few nodules; strongly calcareous, few fine veins and specks of lime; moderately alkaline; clear, smooth boundary.

C2ca—24 to 37 inches, white (10YR 8/2) very fine sandy loam, pale brown (10YR 6/3) moist; weak, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, medium, and coarse roots; common, very fine, tubular pores; common, rounded, firm cicada krotovinas; common subrounded nodules; strongly calcareous, few fine and medium veins of lime; moderately alkaline; abrupt, smooth boundary.

IIC3ca—37 to 44 inches, light brownish-gray (10YR 6/2) light loam, brown (10YR 4/3) moist; weak, very thin, platy structure; slightly hard, firm, nonsticky and slightly plastic; very few very fine roots; many, very fine, tubular pores; moderately alkaline; gradual, smooth boundary.

IIC4ca—44 to 60 inches, white (10YR 8/2) light loam, brown (10YR 5/3) moist; weak, very thin, platy structure; few discontinuous lenses that have moderate, very thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many, very fine, tubular pores; moderately calcareous, few fine veins of lime; moderately alkaline.

The A horizon ranges from light brownish gray or pale brown (10YR 6/2 or 6/3) to grayish brown or brown (10YR 5/2 or 5/3) in color. In some areas the B horizon is loam or silt loam, but in places it has been destroyed by plowing or land leveling. The depth to the Cca horizon ranges from 10 to 14 inches. Sand, gravelly sand, or bedrock is below a depth of 40 inches in some areas.

Included with this soil in mapping were small areas of Paulville loam, small areas of a soil that is similar to Declo loam, 0 to 2 percent slopes, but is more than 14 inches deep to the upper part of the substratum, and spots where the upper part of the substratum has been exposed by land leveling.

This Declo soil has moderate permeability. The available water capacity is 9 to 11 inches. Runoff is slow, and the hazards of water and wind erosion are none to slight.

This soil is used for sugar beets, beans, potatoes, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range. It is easily worked throughout a fairly wide range of moisture content. (Capability unit IIC-50, irrigated; capability unit VIC-835, nonirrigated; windbreak group 71)

**Declo loam, 2 to 4 percent slopes** (DmB).—This soil is on the sides of slight ridges on low terraces and the basalt plains. Areas of this soil are generally oblong. This soil is similar to Declo loam, 0 to 2 percent slopes, except that it is very gently sloping. The hazard of water erosion is moderate in irrigated areas and none to slight in dryland areas.

This soil is used for sugar beets, beans, potatoes, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range. (Capability unit IIC-50, irrigated;

capability unit VIc-835, nonirrigated; windbreak group 71)

**Declo loam, 4 to 8 percent slopes (DmC).**—This soil is on the sides of ridges. It is similar to Declo loam, 0 to 2 percent slopes, except that it is gently sloping and the upper part of the substratum has been mixed into the plow layer in more spots. Runoff is medium. The hazard of water erosion is high in irrigated areas and moderate in dryland areas.

This soil is used for potatoes, beans, sugar beets, wheat, mixed grains, barley, alfalfa hay, pasture, and range, or it is idle. (Capability unit IIIe-50, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

**Declo fine sandy loam, 0 to 2 percent slopes (DIA).**—This soil is similar to Declo loam, 0 to 2 percent slopes, except that it has a surface layer of fine sandy loam about 10 inches thick. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Escalante fine sandy loam, Kecko fine sandy loam, and Paulville fine sandy loam.

This Declo soil is used for sugar beets, beans, potatoes, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range, or it is idle. It can be worked throughout a wide range of moisture content. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

## Escalante Series

The Escalante series consists of deep and very deep, well-drained, level to gently sloping soils that formed in alluvium and wind-laid material that is of mixed mineralogy. These soils are on undulating basalt plains and slight ridges on low terraces. The native vegetation is big sagebrush, rabbitbrush, needle-and-thread, Indian ricegrass, and Sandberg bluegrass. Elevation is 4,150 to 4,200 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is about 48° F., and the frost-free season is about 130 days. Associated are soils of the Declo and Portneuf series.

Most of these soils are noncalcareous in the upper 7 inches after mixing and are outside the defined range for the series. This difference does not alter their use or behavior.

In a representative profile, the surface layer is light brownish-gray and pale-brown loamy fine sand and fine sandy loam about 7 inches thick. The subsoil is pale-brown fine sandy loam about 5 inches thick. The upper part of the substratum is light-gray and very pale brown fine sandy loam that extends to a depth of 44 inches. The lower part is very pale brown loamy fine sand that extends to a depth of 50 inches and more. The profile is limy below a depth of 7 inches.

Escalante soils are used for irrigated row crops, hay, and pasture and for range.

**Escalante fine sandy loam, 0 to 2 percent slopes (EsA).**—This soil is on flat tops of slight ridges on low terraces. The soil areas are oblong or irregularly shaped and 4 to 50 acres in size.

Representative profile, 250 feet west and 75 feet south of the northeast corner of the NE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 25, T. 9

S., R. 22 E., 2 $\frac{1}{2}$  miles west and 1 mile north of Paul, in a noncultivated area where the slope is 0.5 percent.

A11—0 to 1 inch, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure and single grain; soft, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline; abrupt, smooth boundary.

A12—1 to 7 inches, pale-brown (10YR 6/3) fine sandy loam, brown to dark brown (10YR 4/3) moist; weak, coarse and medium, subangular blocky structure parting to weak, fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots and few medium roots; common, fine and very fine, interstitial pores and few, fine, tubular pores; mildly alkaline; clear, smooth boundary.

B—7 to 12 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine, tubular pores; slightly calcareous to moderately calcareous; moderately alkaline; clear, smooth boundary.

C1ca—12 to 16 inches, light-gray (10YR 7/2) fine sandy loam, pale brown (10YR 6/3) moist; very weak, medium, subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine, tubular pores; common, firm to very firm,  $\frac{1}{4}$ - to  $\frac{1}{2}$ -inch cicada krotovinas; moderately calcareous or strongly calcareous; moderately alkaline; clear, wavy boundary.

C2ca—16 to 27 inches, light-gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; weak, coarse, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots that grow along interfaces between peds; common, very fine, tubular pores; many very firm cicada krotovinas; strongly calcareous, common veins of lime; moderately alkaline; clear, wavy boundary.

C3ca—27 to 35 inches, very pale brown (10YR 7/3) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many, very fine, interstitial pores; few firm cicada krotovinas; common, firm, subrounded nodules that are darker colored than the matrix; moderately calcareous, few fine veins of lime; moderately alkaline; clear, smooth boundary.

C4ca—35 to 44 inches, very pale brown (10YR 7/3) light fine sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and slightly plastic; few very fine roots; few, very fine, interstitial and tubular pores; slightly to moderately calcareous, few fine splotches of lime; moderately alkaline; clear, smooth boundary.

IIC5—44 to 50 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; massive, soft, very friable, nonsticky and nonplastic; slightly calcareous; moderately alkaline.

The A horizon ranges from light brownish gray or pale brown (10YR 6/2 or 6/3) to grayish brown or brown (10YR 5/2 or 5/3) in color. Depth to the strongly calcareous C2ca horizon ranges from 10 to 18 inches. The soil is generally more than 60 inches deep, but in some areas it is underlain by basalt, sand, or gravelly sand at a depth of more than 40 inches.

Included with this soil in mapping were spots where cuts made during leveling exposed the light-colored, calcareous horizon. Also included were small areas of Declo fine sandy loam, Kecko fine sandy loam, Escalante loamy sand, and a soil that has a texture of fine sandy loam but lacks a strongly calcareous horizon.

This soil has moderately rapid permeability. The available water capacity is 7 to 9 inches. Runoff is slow, the

hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range. It can be worked throughout a wide range of moisture content. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Escalante fine sandy loam, 2 to 4 percent slopes (EsB).**—This soil is on the sides of ridges on low terraces and on the sides of drainageways on basalt plains. It is similar to Escalante fine sandy loam, 0 to 2 percent slopes, except that it is very gently sloping. The strongly calcareous part of the substratum is at a depth of 7 to 10 inches. In irrigated areas runoff is slow to medium, the hazard of water erosion is moderate, and the hazard of wind erosion is slight. In dryland areas the hazards of wind and water erosion are none to slight.

Included with this soil in mapping were scattered areas of Declo fine sandy loam.

This Escalante soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range. (Capability unit IIe-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Escalante fine sandy loam, 4 to 8 percent slopes (EsC).**—This soil is on the sides of drainageways on basalt plains and the sides of ridges on low terraces. It is similar to Escalante fine sandy loam, 0 to 2 percent slopes, except that it is gently sloping. In irrigated areas runoff is medium, the hazard of water erosion is high, and the hazard of wind erosion is none to slight. In dryland areas the hazard of water erosion is moderate, and the hazard of wind erosion is none to slight.

Included with this soil in mapping were small areas where slopes are 8 to 12 percent.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, alfalfa hay, pasture, and range. (Capability unit IIIe-50, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

## Feltham Series

The Feltham series consists of very deep, well-drained to somewhat excessively drained, level or nearly level to gently sloping soils. These soils formed in stratified alluvium and eolian deposits on low terraces and basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, rabbitbrush, needle-and-thread, Indian ricegrass, and Sandberg bluegrass. Elevation is 4,150 to 4,250 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Kecko, Quincy, Somsen, Tindahay, and Vining series.

In a representative profile, the surface layer is pale-brown loamy sand about 8 inches thick. The upper part of the substratum is light brownish-gray and pale-brown loamy sand that extends to a depth of about 26 inches. The lower part is light-gray to white sandy loam and loamy sand that extends to a depth of 58 inches. An unconformable layer of gravelly coarse sand is between depths of 58 and 66 inches. The profile is limy, except between depths of 8 and 26 inches.

Feltham soils are used for row crops, hay, pasture, and range.

**Feltham loamy sand, 0 to 4 percent slopes (FeB).**—This soil is on the sides of slight ridges in mainly flat to slightly convex areas on low terraces and loess-covered basalt uplands. The soil areas are irregularly shaped and oblong and 5 to 50 acres in size.

Representative profile, 250 feet east and 200 feet south of the northwest corner of the NE $\frac{1}{4}$  sec. 20, T. 9 S., R. 24 E., 0.25 mile north of Rupert, in a pasture where the slope is 0.2 percent.

Ap—0 to 8 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; very weak, medium, subangular blocky structure parting to weak, very fine, granular; slightly hard, very friable, nonsticky and slightly plastic; common very fine, fine, and medium roots; many, very fine, interstitial pores; slightly calcareous; mildly alkaline; abrupt, smooth boundary.

C1—8 to 15 inches, light brownish-gray (10YR 6/2) loamy sand, brown (10YR 4/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine and fine roots; few, very fine and fine, tubular pores and many, very fine, interstitial pores; mildly alkaline; clear, smooth boundary.

C2—15 to 26 inches, pale-brown (10YR 6/3) light loamy sand, brown (10YR 4/3) moist; weak, very coarse, subangular blocky structure or massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots, common in lower inch; many, very fine, interstitial pores; mildly alkaline; abrupt, smooth boundary.

C3ca—26 to 32 inches, white (10YR 8/2) sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; many, very fine, tubular pores; moderately calcareous; moderately alkaline; clear, smooth boundary.

C4ca—32 to 36 inches, light-gray (10YR 7/1) light sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; few roots; many, very fine, tubular pores; moderately calcareous; moderately alkaline; clear, smooth boundary.

C5ca—36 to 58 inches, light-gray (10YR 7/2) light loamy sand, grayish brown (10YR 5/2) moist; massive; loose, very friable, nonsticky and nonplastic; few very fine roots; many, very fine, interstitial pores; moderately calcareous; moderately alkaline; abrupt, smooth boundary.

IIC6—58 to 66 inches, gravelly coarse sand that has lenses of finer material; slightly calcareous.

The A horizon ranges from brown or grayish brown (10YR 5/3 or 5/2) to pale brown or light brownish gray (10YR 6/3 or 6/2) in color. The loamy sand Ap, C1, and C2 horizons range from 25 to 35 inches in combined thickness. A layer of lime accumulation has an upper boundary at depths between 20 and 30 inches. Depth to gravelly coarse sand or coarse sand ranges from 40 to 60 inches.

Included with this soil in mapping were small areas of Kecko loamy sand, Paulville loamy sand, Quincy loamy sand, Tindahay loamy sand, and a soil that is similar to this Feltham soil but is calcareous throughout.

This soil has rapid permeability. The available water capacity is 4 to 6 inches. Runoff is very slow, and the hazard of water erosion is none to slight. The hazard of wind erosion is high.

This soil is used for beans, barley, wheat, mixed grains, alfalfa hay, pasture, and range. Choice of crops is limited by the available water capacity in the upper part of the soil. This soil is easily worked throughout a wide range of moisture content. (Capability unit IIIe-73,

irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

**Feltham loamy sand, 4 to 8 percent slopes (FeC).**—This soil is on the sides of ridges and drainageways on terraces and basalt plains. It is similar to Feltham loamy sand, 0 to 4 percent slopes, except that it is gently sloping. Runoff is slow to medium. The hazard of water erosion is high in irrigated areas and slight in dryland areas.

Included with this soil in mapping were small areas of Kecko loamy sand, Quincy loamy sand, and Quincy sand.

This Feltham soil is used mainly for range. In cultivated areas it is used for beans, barley, wheat, mixed grains, and alfalfa hay. (Capability unit IVE-74, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

## Kecko Series

The Kecko series consists of deep and very deep, well-drained, nearly level to gently sloping soils that formed in mixed alluvium that had been influenced by windlaid sands. These soils are on low alluvial fans, terraces, and slight ridges and broad drainageways on basalt plains. In areas that are not cultivated the vegetation is big sagebrush, needle-and-thread, Indian ricegrass, and Sandberg bluegrass. Elevation is 4,150 to 4,300 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Escalante, Declo, and Vining series.

In a representative profile, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is brown and pale-brown fine sandy loam that extends to a depth of about 29 inches. The substratum is stratified light-gray and light brownish-gray loam, fine sandy loam, loamy sand, and silt loam that extends to a depth of 72 inches. These soils are limy, except between depths of 22 and 29 inches.

Kecko soils are used for irrigated row crops, hay, and pasture and for range, or they are idle.

**Kecko fine sandy loam, 0 to 2 percent slopes (KeA).**—This soil is on low terraces or alluvial fans and in drainageways on loess-covered basalt plains. The soil areas are long, irregularly shaped to oblong or somewhat rounded, and 5 to 240 acres in size.

Representative profile, 570 feet south and 72 feet east of the northwest corner of SE $\frac{1}{4}$  sec. 6, T. 9 S., R. 24 E., 1 mile west and 4 miles north of Rupert, in a grainfield where the slope is 0.5 percent.

Ap—0 to 9 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine and medium, subangular blocky structure parting to weak, very fine, granular; slightly hard, friable, nonsticky and nonplastic; common very fine roots and few fine roots; many, very fine, interstitial pores and common, very fine and fine, tubular pores; few wormholes; few fine spots of lime; mildly alkaline; abrupt, smooth boundary.

B1—9 to 22 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist, dark grayish brown (10YR 4/2) crushed and moist; very weak, very coarse and medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic;

common very fine roots; many, very fine and fine, interstitial pores; few wormholes; discontinuous layers of loamy sand about 1 inch thick; few fine spots of lime; mildly alkaline; clear, smooth boundary.

B2—22 to 29 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, tubular pores and few, fine, tubular pores; few worm channels and casts; few hard krotovinas; mildly alkaline; clear, smooth boundary.

C1ca—29 to 36 inches, light-gray (10YR 7/2) light loam, brown (10YR 5/3) moist; weak, fine and medium, subangular blocky structure but very thin, platy in a few pockets; hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, tubular pores and few, fine and medium, tubular pores; about 10 percent rounded hard krotovinas; strongly calcareous; moderately alkaline; abrupt, smooth boundary.

C2ca—36 to 42 inches, light brownish-gray (10YR 6/2) fine sandy loam, brown (10YR 4/3) moist; very weak, medium and coarse, subangular blocky structure but platy in a few pockets; hard, friable, slightly sticky and slightly plastic; few very fine roots; many, very fine, tubular pores and few, fine, tubular pores; about 10 percent hard krotovinas; strongly calcareous, few fine veins of lime, but many in the pockets where structure is platy; moderately alkaline; abrupt, smooth boundary.

C3—42 to 47 inches, light brownish-gray (10YR 6/2) heavy loamy sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many, very fine, interstitial pores and common, fine, tubular pores; few krotovinas; moderately calcareous; moderately alkaline; clear, smooth boundary.

C4ca—47 to 67 inches, light brownish-gray and light-gray (10YR 6/2 and 7/2), stratified layers of silt loam and sandy loam, 2 to 7 inches thick, and discontinuous pockets of slightly calcareous, massive loamy sand, brown (10YR 5/3) moist; silt loam has weak, very thin, platy structure, sandy loam is mostly massive; few very fine roots; many, very fine, tubular pores; silt loam is strongly calcareous, sandy loam is moderately calcareous; moderately alkaline.

The Ap horizon ranges from brown or grayish brown (10YR 5/3 or 5/2) to pale brown or light brownish gray (10YR 6/3 or 6/2) in color. It is calcareous in places because of land leveling. In the B horizon in some areas there are clay films on some ped surfaces. A layer of lime accumulation has an upper boundary at depths between 20 and 30 inches, and 6 inches or more of it is strongly calcareous. In some areas the soil is stony or is underlain by bedrock or gravelly sand below a depth of 40 inches. In other areas gravelly sand is at depths between 40 and 60 inches.

Included with this soil in mapping were small areas of soils that have a surface layer of loamy sand. Also included were small areas of Escalante fine sandy loam, Clems fine sandy loam, and a soil that is similar to this Kecko soil but is dominantly loam between depths of 10 to 40 inches.

This soil has moderately rapid permeability. The available water capacity is 7 to 9 inches. Runoff is slow, the hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

This soil is used for potatoes, sugar beets, corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, pasture, and range. It can be worked throughout a wide range of moisture content. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Kecko fine sandy loam, 2 to 4 percent slopes (KeB).**—This soil occupies sides of low ridges on terraces and basalt plains. It is similar to Kecko fine sandy loam, 0 to 2 percent slopes, except that it is very gently sloping. Mapped areas of this soil are mostly oblong and generally smaller than those of the representative soil. In irrigated areas runoff is slow to medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This soil is used for potatoes, sugar beets, corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and range. (Capability unit IIe-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Kecko loamy fine sand, 0 to 4 percent slopes (KcB).**—This soil is on the sides of low ridges on terraces and basalt plains. It is similar to Kecko fine sandy loam, 0 to 2 percent slopes, except that it has a surface layer of loamy fine sand about 10 inches thick. The hazard of wind erosion is high.

Included with this soil in mapping were small areas of Feltham loamy fine sand.

This Kecko soil is used for potatoes, sugar beets, corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and range. (Capability unit IIIe-75, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 71)

## Kimama Series

The Kimama series consists of very deep, well-drained, level or nearly level soils that formed in alluvium derived from loess deposits. These soils are in depressions and drainageways and on low alluvial fans associated with loess-covered basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. Elevation is 4,150 to 4,400 feet. The average annual precipitation is 8 to 10 inches, but these soils also receive runoff from higher areas. Average annual temperature is 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Portneuf and Wheeler series.

In a representative profile, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale-brown silt loam that extends to a depth of 33 inches. Below this is light-gray and pale-brown silt loam that extends to a depth of 64 inches. These soils are limy below a depth of 27 inches.

Kimama soils are used for row crops, hay, pasture, and range.

**Kimama silt loam (0 to 2 percent slopes) (Km).**—This soil is in elongated and irregularly shaped to somewhat oval areas in narrow to broad drainageways and depressions and on low alluvial fans. The soil areas are 10 to 640 acres in size.

Representative profile, 1,055 feet south and 200 feet west of the northeast corner of NW¼ sec. 18, T. 8 S., R. 26 E., 1.5 miles southeast and 1.2 miles south of Minidoka, in Blaine County, Idaho, in a noncultivated area where the slope is less than 0.25 percent.

A1—0 to 4 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak, very thin, platy structure parting to weak, very fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots and few fine roots;

many, very fine, interstitial pores and tubular pores; slightly acid; abrupt, smooth boundary.

A3—4 to 8 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist, dark brown (10YR 3/3) crushed and moist; very weak, medium, prismatic structure parting to weak, very fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots and few medium roots; common, very fine, tubular pores; neutral; clear, smooth boundary.

B21t—8 to 17 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; very weak, medium, prismatic structure parting to moderate, very fine and fine, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, tubular pores; thin patchy clay films on vertical and horizontal surfaces of peds and in pores; few hard cicada krotovinas; neutral; clear, smooth boundary.

B22t—17 to 27 inches, brown (10YR 5/3) silt loam, pale brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; moderate, very fine and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; common, very fine, tubular pores; thin patchy clay films on vertical and horizontal surfaces of peds and pores; many hard cicada krotovinas; neutral; clear, smooth boundary.

B3t—27 to 33 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate, very fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common, very fine, tubular pores; few thin clay films on surfaces of peds and pores; common hard cicada krotovinas; slightly calcareous; mildly alkaline; clear, wavy boundary.

Cca—33 to 54 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many, very fine, tubular pores; common cicada krotovinas; strongly calcareous, many fine veins of lime and few coatings of lime; moderately alkaline; clear, wavy boundary.

Bbca—54 to 64 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; very weak, coarse, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; very few very fine roots; many, very fine, tubular pores; few cicada krotovinas; moderately calcareous; few fine veins of lime and few coatings of lime; moderately alkaline; clear, smooth boundary.

The A horizon ranges from 7 to 12 inches in thickness and from brown (10YR 5/3) to grayish brown (10YR 5/2) in color. The Bt horizon ranges from silt loam to heavy silt loam. The upper boundary of the Cca horizon is at a depth of 20 to 43 inches.

Included with this soil in mapping were small areas of Portneuf silt loam, areas of a soil that is similar to this Kimama soil but lacks a horizon of clay accumulation, areas of a soil that is more than 15 percent fine sand or coarser, and areas of a soil that does not have a layer of strong lime accumulation.

This Kimama soil has moderate permeability. The available water capacity is 11 or 12 inches. Runoff is slow, and the hazards of wind and water erosion are none to slight.

This soil is used for sugar beets, potatoes, corn for silage, peas, beans, wheat, mixed grains, barley, alfalfa hay, pasture, and range. It can be worked throughout a fairly wide range of moisture content. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

## Maxey Series

The Maxey series consists of very deep, somewhat poorly drained, level or nearly level soils that formed in stratified alluvium and eolian deposits on low terraces, mainly in the area south of Rupert. The water table fluctuates between depths of 30 and 40 inches in summer. Elevation is about 4,150 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Decker, Schodson, and Wodskow series.

In a representative profile, the surface layer is brown loamy fine sand about 9 inches thick. The upper part of the substratum is pale-brown loamy fine sand that extends to a depth of 26 inches. The lower part is light-gray to light brownish-gray and white, stratified sandy loam, loam, loamy sand, and silt loam that extends to a depth of 63 inches. These soils are limy below a depth of 26 inches.

Maxey soils are used for row crops, hay, and pasture. Most areas of these soils are cultivated.

**Maxey loamy fine sand** (0 to 2 percent slopes) (Mo).—This soil is on low terraces. Slopes are mainly between 0.2 and 1 percent. The soil areas are irregularly shaped or oval and 6 to 90 acres in size.

Representative profile, 340 feet east and 160 feet south of the northwest corner of the SE $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 16, T. 10 S., R. 24 E., about 4 miles south of Rupert, in an alfalfa field where the slope is 0.2 percent.

Ap—0 to 9 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist, dark brown (10YR 4/3) crushed and moist; very weak, very fine, granular structure or massive; slightly hard, very friable, nonsticky and nonplastic; common very fine, fine, and medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; neutral; abrupt, smooth boundary.

C1—9 to 19 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; few, fine, faint mottles that are dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine, fine, and medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; neutral; abrupt, smooth boundary.

C2—19 to 26 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; common, fine, distinct, very dark grayish-brown (10YR 3/2) and very dark gray (10YR 3/1) mottles, dark yellowish brown (10YR 3/4) and black (10YR 2/1) moist; massive; slightly hard, very friable, nonsticky and slightly plastic; common very fine and fine roots and few medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; neutral; clear, smooth boundary.

IIC3ca—26 to 38 inches, light-gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) moist; common, fine, distinct, brown (10YR 5/3) mottles that are dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; common, very fine, tubular pores; moderately calcareous, few splotches of lime; moderately alkaline; clear, smooth boundary.

IIC4ca—38 to 46 inches, light brownish-gray (10YR 6/2) and white (10YR 8/2), stratified light loam and light sandy loam, dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) moist; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; weak, very thin, platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very

fine roots; common, very fine, tubular pores; moderately calcareous, many splotches and fine spots of lime; moderately alkaline; abrupt, smooth boundary.

IVC5ca—46 to 59 inches, light-gray (10YR 7/2) light loam, grayish brown (10YR 5/2) moist; common, fine, distinct, brown (10YR 5/3) mottles that are very dark yellowish brown (10YR 4/4) moist; massive but very thin platy structure in pockets; slightly hard, firm, slightly sticky and slightly plastic; no roots; common, very fine, tubular pores; discontinuous  $\frac{1}{2}$ - to 1-inch layers that are firm or very weakly cemented; moderately calcareous, common splotches and medium veins of lime; moderately alkaline; clear, smooth boundary.

VC6—59 to 63 inches, loamy sand; moderately calcareous; discontinuous layers of silt loam.

The Ap horizon ranges from 7 to 10 inches in thickness and from pale brown (10YR 6/3) to brown (10YR 5/3) in color. The loamy fine sand A1, C1, and C2 layers range from 18 to 30 inches in combined thickness. A layer of moderately coarse textured or medium-textured material has an upper boundary at depths between 18 and 30 inches. The average texture between depths of 10 and 40 inches is loamy fine sand or loamy sand. Coarse sand and gravelly coarse sand is below a depth of 40 inches in some areas. A layer of moderate lime accumulation has an upper boundary at depths between 18 and 30 inches.

Included with this soil in mapping were small areas that are saline. Also included were small areas of Arloval loamy fine sand, Feltham loamy sand, Wodskow sandy loam, and a soil that is similar to this Maxey soil but is calcareous throughout.

This soil has moderately rapid permeability. The available water capacity is 6 or 7 inches. Runoff is very slow; the hazard of water erosion is none to slight. The hazard of wind erosion is high.

This soil is used for sugar beets, corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and irrigated pasture. Choice of crops is limited somewhat by the high water table in summer. The soil is easily worked throughout a wide range of moisture content. (Capability unit IIIe-73, irrigated; windbreak group 76)

## Minidoka Series

The Minidoka series consists of moderately deep, well-drained, level or nearly level to sloping soils that formed in loess deposits on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. Elevation is 4,200 to 4,400 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 125 days. Associated are soils of the Portino, Portneuf, and Trevino series.

In a representative profile, the surface layer is light brownish-gray silt loam 10 inches thick. The upper part of the substratum is light-gray and white silt loam that extends to a depth of 24 inches and is underlain by an indurated hardpan cemented with lime and silica. The profile is limy throughout.

Minidoka soils are used for row crops, hay, pasture, and range.

**Minidoka silt loam, 2 to 4 percent slopes** (MkB).—This soil is in slightly convex areas of loess-covered basalt plains. It is on the sides of drainageways or depressed areas and on low buttes. The soil areas are oblong or elongated and irregularly shaped and are 20 to 3,000 acres in size. Small patches where there are few to many angular

cobblestones and stones are fairly common, unless the stones have been picked. Rock outcrops are common.

Representative profile (fig. 5), 186 feet north and 345 feet west of a well in the southeast corner of the NW $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 7, T. 7 S., R. 25 E., 5 miles west and 5 miles north of Minidoka, in a potato field where the slope is 2 percent.

Ap—0 to 10 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, very fine and fine, granular structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine, tubular pores; moderately calcareous; moderately alkaline; abrupt, smooth boundary.

C1ca—10 to 17 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak, medium and thick, platy structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, interstitial pores and few, very fine, tubular pores; common cicada krotovinas; strongly calcareous, prominent lime coatings on ped faces; moderately alkaline; clear, wavy boundary.

C2casi—17 to 24 inches, white (10YR 8/2) silt loam, light brownish gray (10YR 6/2) moist; massive; very hard, very firm, slightly sticky and slightly plastic; few very fine and fine roots; common, very fine, tubular pores; common cicada krotovinas; common spots and veins of lime; strongly calcareous; partly weakly cemented; moderately alkaline; abrupt, smooth boundary.

C3sicam—24 to 36 inches, indurated duripan; calcareous plates 0.5 inch to 3 inches thick have coatings of opal or other silica on all faces; tops of peds are smooth, undersides are rough and irregular because of coatings of salt crystals; plates are separated by less cemented soil material.

The A horizon ranges from light brownish gray or pale brown (10YR 6/2 to 6/3) to grayish brown or brown (10YR 5/2 or 5/3) in color. A layer of strong lime accumulation has an upper boundary at depths between 7 and 15 inches. The depth to the hardpan ranges from 20 to 40 inches. In some places depth to bedrock is more than 40 inches.

Included with this soil in mapping were small areas of Kimama silt loam, Portino silt loam, Portneuf silt loam, Trevino silt loam, and a soil that is less than 18 inches deep to a hardpan. In the extreme northern part of the survey area, some soils were included that have a weakly cemented hardpan.

This Minidoka soil has moderate permeability above the hardpan. Roots penetrate to the hardpan, and deep-rooted crops penetrate cracks in the hardpan. The available water capacity is 5 to 7.5 inches. Runoff is slow to medium, and the hazard of water erosion is none to slight in dryland areas and moderate in irrigated areas. The hazard of wind erosion is none to slight.

This soil is used for sugar beets, potatoes, peas, wheat, mixed grains, barley, alfalfa hay, pasture, and range. It is easily worked throughout a fairly wide range of moisture content. (Capability unit IIe-51, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Minidoka silt loam, 0 to 2 percent slopes (MkA).**—This soil is on loess-covered basalt plains. It is similar to Minidoka silt loam, 2 to 4 percent slopes, except that it is level or nearly level. The hazard of water erosion is none to slight.

This soil is used for sugar beets, potatoes, peas, mixed grains, barley, alfalfa hay, pasture, and range. (Capability unit IIs-55, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Minidoka silt loam, 4 to 8 percent slopes (MkC).**—This soil is on the sides of drainageways and depressions and on low buttes. It is similar to Minidoka silt loam, 2 to 4 percent slopes, except that it is gently sloping. Runoff is medium. The hazard of water erosion is high in irrigated areas and moderate in dryland areas.

This soil is used for sugar beets, potatoes, peas, wheat, mixed grains, barley, alfalfa hay, pasture, and range. (Capability unit IIIe-52, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

**Minidoka silt loam, 8 to 12 percent slopes (MkD).**—This soil is on the sides of drainageways and depressions and on low buttes. It is similar to Minidoka silt loam, 2 to 4 percent slopes, except that it is sloping. Mapped areas of this soil are oblong and 5 to 20 acres in size. Runoff is rapid. The hazard of water erosion is very high in irrigated areas and high in dryland areas.

Included with this soil in mapping were small areas of Portino silt loam, Portneuf silt loam, and Trevino silt loam.

This Minidoka soil is used mainly for range or is idle. A small acreage is used for barley, mixed grains, wheat, alfalfa hay, and pasture. (Capability unit IVe-52, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)



Figure 5.—Profile of Minidoka silt loam, 2 to 4 percent slopes. A strongly calcareous layer begins at a depth of 10 inches, and an indurated hardpan begins at a depth of about 2 feet.

## Paulville Series

The Paulville series consists of very deep, well-drained, level and nearly level soils that formed in somewhat stratified alluvium that is of mixed mineralogy. These soils are on low terraces. Elevation is about 4,150 feet, and the average annual precipitation is 9 or 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Declo series and the clayey subsoil variant of the Paulville series.

In a representative profile, the surface layer is brown loam about 10 inches thick. The subsoil is brown heavy loam that extends to a depth of 21 inches. The upper part of the substratum is light-gray silt loam that extends to a depth of 35 inches. Below this is white loam that extends to a depth of 42 inches. Between depths of 42 and 47 inches is light-gray loamy fine sand, and below this is light brownish-gray fine sand that extends to a depth of 60 inches. Below a depth of 21 inches, the soil is limy throughout.

Paulville soils are used for row crops, hay, and pasture.

**Paulville loam** (0 to 2 percent slopes) (Pe).—This soil is on low terraces. The soil areas are somewhat rounded to long and irregularly shaped. They are 10 to 400 acres in size.

Representative profile, 290 feet north and 660 feet west of the southeast corner of the NE¼ sec. 15, T. 9 S., R. 23 E., 1 mile east and 2 miles north of the Paul sugar factory, in a beanfield where the slope is 0.25 percent.

Ap—0 to 10 inches, brown (10YR 5/3) loam, pale brown (10YR 6/3) crushed, dark brown (10YR 3/3) moist, dark grayish brown (10YR 4/2) crushed and moist; very weak, fine, subangular blocky structure parting to very weak, fine and very fine, granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, tubular pores and common, fine, tubular pores; common worm channels and casts; mildly alkaline; abrupt, smooth boundary.

B2t—10 to 21 inches, brown (10YR 5/3) heavy loam, pale brown (10YR 6/3) crushed, dark brown (10YR 3/3) moist, dark brown (10YR 4/3) crushed and moist; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular pores; thin patchy clay films on vertical and horizontal surfaces; few worm channels and casts; some worm channels filled with light-gray limy material; mildly alkaline; abrupt, smooth boundary.

IIC1ca—21 to 35 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, tubular pores; few rounded krotovinas; strongly calcareous, few fine and medium veins and splotches of lime; moderately alkaline; abrupt, smooth boundary.

IIC2ca—35 to 42 inches, white (10YR 8/2) heavy loam, pale brown (10YR 6/3) moist; very weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine and fine, tubular pores; few krotovinas; strongly calcareous, few fine veins and splotches of lime; moderately alkaline; abrupt, smooth boundary.

IVC3—42 to 47 inches, light-gray (10YR 7/2) loamy fine sand, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many, very fine, interstitial pores and few, very fine, tubu-

lar pores; few fine pedes from the IIC2ca horizon; moderately calcareous, few veins of lime; moderately alkaline; abrupt, smooth boundary.

VC4—47 to 60 inches, light brownish-gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose, nonsticky and nonplastic; very few very fine and fine roots; slightly calcareous; moderately alkaline.

The Ap horizon ranges from pale brown or light brownish gray (10YR 6/3 or 6/2) to brown or grayish brown (10YR 5/3 or 5/2) in color. The B2t horizon ranges from 7 to 12 inches in thickness. It is heavy loam to light clay loam or light silty clay loam. The ca horizon commonly has an upper boundary at depths between 15 and 30 inches, but in places is at a depth of less than 15 inches because of land leveling operations. Depth to sand or gravelly sand ranges from 40 to 60 inches.

Included with this soil in mapping were spots where cuts made during leveling have exposed the layer of lime accumulation. Also included were small areas where slopes are 2 to 4 percent and small areas of Abo loam; Declo loam; Paulville silt loam, clayey subsoil variant; a soil that is similar to this Paulville soil but is only 20 to 40 inches deep over sand; and a soil that does not have a layer of clay accumulation or a layer of lime accumulation.

This Paulville soil has moderately slow permeability. The available water capacity is 8 to 10 inches. Runoff is slow, and the hazards of water and wind erosion are none to slight.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, alfalfa hay, and pasture. It can be worked throughout a fairly wide range of moisture content. (Capability unit IIC-50, irrigated; wind-break group 71)

**Paulville clay loam** (0 to 2 percent slopes) (Pm).—This soil is similar to Paulville loam, except that the surface layer is clay loam. Some of the mapped areas are as large as 1,000 acres in size. Runoff is very slow. Included with this soil in mapping were small areas of Paulville silty clay loam, clayey subsoil variant.

This Paulville soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, hay, and pasture. It can be worked only within a narrow range of moisture content. (Capability unit IIC-50, irrigated; windbreak group 71)

**Paulville fine sandy loam** (0 to 2 percent slopes) (Pd).—This soil is similar to Paulville loam, except that the surface layer is fine sandy loam and the profile is slightly more sandy. The hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Abo fine sandy loam, Declo fine sandy loam, Kecko fine sandy loam, and Paulville loamy fine sand.

This Paulville soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIC-50, irrigated; windbreak group 71)

**Paulville loamy fine sand** (0 to 2 percent slopes) (Pc).—This soil is in slightly convex areas associated with eolian deposits. It is similar to Paulville loam, except that the surface layer is loamy fine sand 10 to 14 inches thick. Mapped areas of this soil are generally smaller than those of Paulville loam. The hazard of wind erosion is high.

Included with this soil in mapping were small areas of Keeko loamy fine sand and Tindahay loamy fine sand.

This Paulville soil is used for sugar beets, beans, corn for silage, wheat, mixed grain, hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIIe-75, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 71)

### Paulville Series, Clayey Subsoil Variant

The Paulville series, clayey subsoil variant, consists of very deep, well-drained, level and nearly level soils that formed mainly in alluvium derived from loess. These soils are in concave areas on low terraces and in undrained basins on loess-covered basalt plains. In areas that are not cultivated, the vegetation is big sagebrush or three-tip sagebrush or silver sage and squirreltail, Sandberg bluegrass, Indian ricegrass, bluebunch wheatgrass, cheatgrass, and weeds. Elevation is 4,150 to 4,400 feet. The average annual precipitation is 8 to 11 inches, but these soils also receive runoff from higher areas. Average annual temperature is about 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Kimama, Paulville, and Portneuf series.

In a representative profile, the surface layer is light brownish-gray light silty clay loam about 8 inches thick. The upper part of the subsoil is brown silty clay that extends to a depth of about 30 inches. The lower part of the subsoil is pale-brown silty clay loam that reaches to a depth of 38 inches. The substratum is light-gray silt loam that extends to a depth of 60 inches. The profile is limy below a depth of 30 inches.

Soils of the Paulville series, clayey subsoil variant, are used for row crops, hay, pasture, and range, or they are left idle.

**Paulville silty clay loam, clayey subsoil variant** (0 to 2 percent slopes) (Pr).—This soil is in slightly concave areas on low terraces, on bottoms of undrained basins, or in depressions on basalt plains. Slopes are mainly less than 1 percent. The soil areas are long to rounded and 2 to 300 acres in size.

Representative profile, 255 feet east and 45 feet north of the southwest corner of the SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 12, T. 9 S., R. 22 E., 1.5 miles west and 3 miles north of Paul.

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) light silty clay loam, pale brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; weak, fine and very fine, granular structure; hard, firm, sticky and plastic; common very fine and fine roots; mildly alkaline; abrupt, smooth boundary.

B21t—8 to 19 inches, brown (10YR 5/3) light silty clay, pale brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; very weak, coarse, prismatic structure parting to moderate, very fine and fine, angular and subangular blocky; very hard, firm, very sticky and very plastic; few very fine and fine roots; common, very fine, tubular pores; thin patchy clay films on vertical and horizontal surfaces of peds and in pores; moderately alkaline; clear, smooth boundary.

B22t—19 to 30 inches, brown (10YR 5/3) light silty clay, pale brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; weak, coarse and medium, prismatic structure parting to moderate, fine and medium, angular and subangular blocky; very hard, firm, very sticky and very plastic; few very fine and fine roots; common, very fine, tubular pores; thin patchy clay films on vertical and horizontal surfaces and in pores; moderately alkaline; clear, smooth boundary.

B3ca—30 to 38 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; very weak, coarse, prismatic structure parting to moderate, fine and very fine, angular and subangular blocky; hard, friable, sticky and plastic; common very fine and fine roots; common, very fine, tubular pores; few hard cicada krotovinas; moderately calcareous; few veins and splotches of lime; moderately alkaline; clear, smooth boundary.

Cca—38 to 60 inches, light-gray (10YR 7/2) silt loam, brown (10YR 4/3) moist; weak, fine and very fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; very few very fine roots; few, very fine, tubular pores; moderately calcareous, common fine veins and splotches of lime; moderately alkaline.

The A horizon ranges from 3 to 8 inches in thickness and from light gray to grayish brown (10YR 7/2 to 5/2) or very pale brown to brown (10YR 7/3 to 5/3) in color. The B2t horizon ranges from heavy silty clay loam to silty clay or clay. The ca horizon has an upper boundary at depths between 18 and 36 inches.

Included with this soil in mapping were small areas of Paulville clay loam, Kimama silt loam, and a soil that is similar to this clayey subsoil variant of Paulville soils but is mottled in the lower part. Also included, on basalt uplands, were areas of a soil that has hues of 2.5Y to 5Y in the subsoil and contains common manganese concretions.

This Paulville soil, clayey subsoil variant, has slow permeability. The available water capacity is 10 to 12 inches. Runoff is ponded, and the hazards of water and wind erosion are none to slight.

This soil is used for sugar beets, corn for silage, wheat, mixed grains, barley, hay, pasture, and range, or it is idle. It can be worked only within a narrow range of moisture content. (Capability unit IIIs-66, irrigated; capability unit VIs-838, nonirrigated; windbreak group 71)

**Paulville silt loam, clayey subsoil variant** (0 to 2 percent slopes) (Pr).—This soil is similar to Paulville silty clay loam, clayey subsoil variant, except that the surface layer is silt loam. Included with this soil in mapping were small areas of Paulville loam and, just north of Acequia, areas of soils that have a surface layer of sandy loam.

This Paulville soil is used for sugar beets, corn for silage, wheat, mixed grains, barley, hay, pasture, and range, or it is idle. It can be worked throughout a fairly wide range of moisture content. (Capability unit IIIs-66, irrigated; capability unit VIs-838, nonirrigated; windbreak group 71)

### Portino Series

The Portino series consists of moderately deep, well-drained, level to sloping soils that formed in wind-laid silt deposits on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. Elevation is 4,200 to 4,700 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 125 days. Associated are soils of the Minidoka, Portneuf, and Trevino series.

In the Minidoka Area, most of these soils are outside the defined range for the series because they are noncalcareous to a depth of 7 inches after mixing. This difference does not alter their use or behavior.

In a representative profile, the surface layer is light brownish-gray silt loam about 4 inches thick. The subsoil is pale-brown silt loam that extends to a depth of 13 inches. The substratum is light-gray and white loam. Bedrock is at a depth of about 28 inches. These soils are limy below a depth of 13 inches and have angular pebbles and cobblestones throughout.

Portino soils are used for row crops, hay, and pasture.

**Portino silt loam, 2 to 4 percent slopes (PsB).**—This soil is in slightly convex areas on the sides of drainageways and depressions on loess-covered basalt plains. The soil areas are generally oblong or irregularly shaped and 10 to 600 acres in size.

Representative profile, 700 feet south and 600 feet east of the northwest corner of sec. 5, T. 8 S., R. 26 E., 2 miles east and 1 mile north of Minidoka, in a sagebrush area where the slope is 2 percent.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, thin and medium, platy structure parting to very weak, very fine, granular; soft, very friable, nonsticky and nonplastic; common very fine and few fine roots; many, very fine, tubular pores; 3 percent angular basalt pebbles; mildly alkaline; abrupt, smooth boundary.

B2—4 to 13 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine, medium, and coarse roots; many, very fine, tubular pores and few, medium, tubular pores; 3 percent angular basalt pebbles and 1 percent angular basalt cobblestones; mildly alkaline; clear, smooth boundary.

C1ca—13 to 16 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; many, very fine, tubular pores; few cicada krotovinas; strongly calcareous, common specks, fine veins, and splotches of lime; 5 percent angular basalt pebbles and 1 percent angular basalt cobblestones; moderately alkaline; clear, smooth boundary.

C2ca—16 to 28 inches, white (10YR 8/1) loam, light gray (10YR 7/2) moist; weak, medium and coarse, subangular blocky structure and weak, medium, platy; hard, firm, slightly sticky and slightly plastic; roots between plates; common, very fine, tubular pores; common cicada krotovinas; 10 percent angular basalt cobblestones; strongly calcareous; moderately alkaline; abrupt, smooth boundary.

IIR—28 to 29 inches, basalt bedrock; lime coatings on surface and in cracks.

The A horizon ranges from 3 to 7 inches in thickness and from light brownish gray or pale brown (10YR 6/2 or 10YR 6/3) to grayish brown or pale brown (10YR 5/2 or 6/3) in color. The B horizon is 6 to 10 inches thick. The soil is noncalcareous to a depth of 7 to 13 inches. A strongly calcareous horizon has an upper boundary at depths between 9 and 14 inches. Bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping were small areas of Minidoka silt loam, Portneuf silt loam, and Trevino very stony silt loam.

This Portino soil has moderate permeability, and roots penetrate to bedrock. The available water capacity is 4.5 to 7 inches. Runoff is slow to medium, the hazard of water erosion is moderate in irrigated areas and none to slight in nonirrigated areas, and the hazard of wind erosion is none to slight.

This soil is used for peas, potatoes, sugar beets, barley, mixed grains, wheat, alfalfa hay, pasture, and range, or it is idle. It can be worked throughout a fairly wide range of moisture content. (Capability unit IIe-51, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Portino silt loam, 0 to 2 percent slopes (PsA).**—This soil is on loess-covered basalt plains. It is similar to Portino silt loam, 2 to 4 percent slopes, except that it is level or nearly level and generally is in smaller areas. Runoff is slow, and the hazard of water erosion is none to slight.

This soil is used for peas, potatoes, sugar beets, barley, mixed grains, hay, pasture, and range, or it is idle. (Capability unit IIs-55, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Portino silt loam, 4 to 8 percent slopes (PsC).**—This soil is on the sides of drainageways and depressions on loess-covered basalt plains. It is similar to Portino silt loam, 2 to 4 percent slopes, except that it is gently sloping. Mapped areas of this soil are generally smaller than those of the representative soil. Runoff is medium, and the hazard of water erosion is high in irrigated areas and moderate in dryland areas.

This soil is used for peas, potatoes, sugar beets, barley, mixed grains, wheat, hay, pasture, and range, or it is idle. (Capability unit IIIs-52, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

**Portino silt loam, 8 to 12 percent slopes (PsD).**—This soil is similar to Portino silt loam, 2 to 4 percent slopes, except that it is more sloping. Mapped areas of this soil are generally elongated and are narrower and much smaller than those of the representative soil. Runoff is rapid, and the hazard of water erosion is very high in irrigated areas and moderate in dryland areas.

Included with this soil in mapping were eroded spots.

This soil is used for barley, mixed grains, wheat, alfalfa hay, pasture, and range, or it is idle. (Capability unit IIVe-52, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

## Portneuf Series

The Portneuf series consists of deep and very deep, well-drained, level and nearly level to sloping soils that formed in loess deposits on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, Sandberg bluegrass, bluebunch wheatgrass, and needle-and-thread or cheatgrass. Elevation is 4,200 to 4,400 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Kimama, Minidoka, Portino, and Trevino series.

In a representative profile, the surface layer is pale-brown silt loam about 9 inches thick. The subsoil is pale-brown silt loam about 4 inches thick. The upper part of the substratum is white and light-gray, slightly hard silt loam that reaches to a depth of 42 inches. The lower part of the substratum is very pale brown, soft silt loam extending to a depth of 64 inches. The profile is limy throughout.

Portneuf soils are used for row crops, hay, pasture, and range.

**Portneuf silt loam, 0 to 2 percent slopes (PvA).**—This soil is on loess-covered basalt plains. It occurs in broad areas between well-defined drainageways and depressions. Mapped areas of this soil are generally long, irregularly shaped, and about 5 to more than 700 acres in size.

Representative profile (fig. 6), 1,320 feet north and 192 feet west of the southeast corner of sec. 8, T. 10 S., R. 22 E., 6 miles west and 3 miles south of Paul, in a bean-field where the slope is about 1 percent.

Ap—0 to 9 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; very weak, very fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few, very fine, tubular pores; slightly calcareous; mildly alkaline; abrupt, smooth boundary.

B—9 to 13 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; common, very fine, tubular pores; few cicada krotovinas in the lower part; strongly calcareous; mildly alkaline; clear, smooth boundary.

C1ca—13 to 27 inches, white (10YR 8/2) silt loam, light brownish gray (10YR 6/2) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many dead roots on ped faces; many, very fine, tubular pores; common hard cicada krotovinas; strongly calcareous, common fine veins and spots of lime and coatings on krotovinas; moderately alkaline; gradual, smooth boundary.

C2ca—27 to 42 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; dead roots on a few ped faces; common, very fine, tubular pores; common hard cicada krotovinas, but softer matrix between the krotovinas; strongly calcareous, few fine spots and veins of lime; moderately alkaline; gradual, smooth boundary.

C3—42 to 64 inches, very pale brown (10YR 7/3) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common, very fine, tubular pores; strongly calcareous; moderately alkaline.

The Ap horizon ranges from pale brown or light brownish gray (10YR 6/3 or 6/2) to brown or grayish brown (10YR 5/3 or 5/2) in color. In small areas where the substratum has been uncovered by land leveling, the color value is 7. A layer of strong lime accumulation has an upper boundary at depths between 7 and 15 inches. In places along this upper boundary there is a discontinuous, weakly cemented layer less than one-sixteenth inch thick. In some areas basalt bed-rock is at a depth of 40 to 60 inches.

Included with this soil in mapping were small areas of Kimama silt loam, Minidoka silt loam, Portino silt loam, Trevino silt loam, Wheeler silt loam, and a soil that has a subsoil of silty clay and that occurs as slickspots.

This Portneuf soil has moderate permeability. Roots penetrate to a depth of 40 inches or more. The available water capacity is 8 to 12 inches. Runoff is slow, and the hazards of water and wind erosion are none to slight.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, alfalfa hay, and pasture or range. The soil is easily worked throughout a fairly wide range of moisture content. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Portneuf silt loam, 2 to 4 percent slopes (PvB).**—This soil is on slightly convex sides of drainageways and depressions. It is similar to Portneuf silt loam, 0 to 2 percent slopes, except that it is very gently sloping and generally is in areas that are elongated and smaller in size. Runoff is slow to medium, and the hazard of water erosion is none to slight in dryland areas but moderate in irrigated areas.

This soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, hay, and pasture or range. (Capability unit IIc-50, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71).

**Portneuf silt loam, 4 to 8 percent slopes (PvC).**—This soil is on the sides of drainageways and depressions and is associated with low buttes. It is similar to Portneuf silt loam, 0 to 2 percent slopes, except that it is gently



Figure 6.—Profile of Portneuf silt loam, 0 to 2 percent slopes.

sloping and is in areas that are elongated and smaller in size. Runoff is medium, and the hazard of water erosion is moderate in dryland areas but high in irrigated areas.

Included with this soil in mapping were small areas of Minidoka silt loam, Portino silt loam, Trevino silt loam, and Wheeler silt loam and spots of eroded soils.

This Portneuf soil is used for sugar beets, potatoes, beans, corn for silage, wheat, mixed grains, barley, hay, pasture, and range. (Capability unit IIIe-50, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

**Portneuf silt loam, 8 to 12 percent slopes (PvD).**—This soil occupies the sides of drainageways. It is similar to Portneuf silt loam, 0 to 2 percent slopes, except that it is sloping and generally is in areas that are more narrow, more elongated, and smaller in size. Runoff is rapid. The hazard of water erosion is moderate in nonirrigated areas and very high in irrigated areas.

Included with this soil in mapping were small areas of Portino silt loam, Trevino silt loam, and Wheeler silt loam and spots of eroded soils.

This Portneuf soil is used mainly for dry pasture or for range, or it is idle. A small part of this acreage is in irrigated fields and used principally for barley, wheat, mixed grains, alfalfa hay, or pasture, and in a few places for beans and peas. (Capability unit IVe-50, irrigated; capability unit VIe-846, nonirrigated; windbreak group 72)

**Portneuf-Trevino complex, 2 to 20 percent slopes (PwE).**—This complex is on basalt plains. It consists of about 45 percent Portneuf silt loam, 25 percent Trevino silt loam, 20 percent Portino silt loam, and 10 percent rock outcrops and extremely shallow soils. The soils and rock outcrops of this complex are so intermingled that they cannot be mapped or used and managed separately. The Portneuf soil is similar to Portneuf silt loam, 0 to 2 percent slopes, except that its slope ranges from 2 to 20 percent. The Portino soil in this complex is similar to Portino silt loam, 2 to 4 percent slopes, except that its slope ranges from 2 to 20 percent. Mapped areas of this complex are long, irregularly shaped or somewhat rounded, and generally smaller than those of Portneuf silt loam, 0 to 2 percent slopes.

Included with these soils in mapping were small areas of Kimama silt loam and Paulville silt loam, clayey subsoil variant.

Runoff is slow to rapid. The hazard of water erosion is none to very high in irrigated areas and none to moderate in dryland areas. The hazard of wind erosion is none to slight.

This complex is used principally for range or irrigated pasture. Small acreages are used the same as the surrounding soils, mainly if sprinkler irrigation is practiced. This is done for convenience in use of machinery and the irrigation system. (Capability unit VIe-55, irrigated; capability unit VIIs-841, nonirrigated; not in a windbreak group)

## Quincy Series

The Quincy series consists of deep and very deep, excessively drained or somewhat excessively drained, level or nearly level to strongly sloping soils that formed in eolian deposits on low terraces and basalt plains. In areas

that are not cultivated, the vegetation is big sagebrush, needle-and-thread, and Indian ricegrass. Elevation is 4,175 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Feltham, Somsen, Tindahay, and Vining series.

In a representative profile, the soil is light brownish-gray sand to a depth of 64 inches. The underlying material is pale-brown sand.

Quincy soils are used for range, pasture, and hay, or they are idle.

**Quincy sand, 2 to 12 percent slopes (QsD).**—This soil is on sand dunes on the low terraces or basalt plains. The soil areas are generally oblong or irregularly shaped and 10 to 200 acres in size.

Representative profile, 365 feet south and 175 feet west of the northeast corner of the SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 10, T. 9 S., R. 23 E., 0.75 mile east and 3 miles north of the Paul sugar factory, in a sagebrush-grass area where the slope is 5 percent.

C1—0 to 64 inches, light brownish-gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grain; loose when dry and moist; many very fine roots and common fine and medium roots grading to few very fine, fine, and medium roots; many interstitial pores; thin and very thin strata of very fine sand and coarse sand below a depth of 24 inches; mildly alkaline or moderately alkaline; clear, smooth boundary.

C2—64 to 79 inches, pale-brown (10YR 6/3) sand, slightly more fines than in C1 horizon, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many interstitial pores; moderately alkaline; gradual, smooth boundary.

The C1 horizon ranges from light brownish gray or pale brown (10YR 6/2 or 6/3) to grayish brown or brown (10YR 5/2 or 5/3) in color. It is dominantly sand, but in some places there is minor stratification with loamy sand. In places finer textured soil material is at depths below 50 inches. In places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping were small areas of Feltham sand, Feltham loamy sand, Tindahay loamy sand, Kecko loamy sand, Somsen loamy sand, and Vining loamy sand.

This Quincy soil has excessive drainage and rapid permeability. Roots penetrate to a depth of 3 feet or more. The available water capacity is 2.5 to 4 inches. Runoff is very slow, and the hazard of water erosion is none or slight. The hazard of wind erosion is very high.

This soil is used for range or is idle. (Capability unit VIIe-969, nonirrigated; not in a windbreak group)

**Quincy-Rock outcrop complex, 2 to 12 percent slopes (QwD).**—This complex consists of 80 percent Quincy sand and 20 percent rock outcrops and extremely shallow soils. The Quincy sand is similar to Quincy sand, 2 to 12 percent slopes, except that it is only on basalt plains. Runoff is very slow, and the hazard of water erosion is none or slight.

Included with this complex in mapping were small areas of Feltham sand, Feltham loamy sand, Somsen loamy sand, and Vining loamy sand.

This complex is used for range. (Capability unit VIIIs-970, nonirrigated; not in a windbreak group)

**Quincy loamy sand, 2 to 4 percent slopes (QuB).**—This soil is similar to Quincy sand, 2 to 12 percent slopes, except that it is loamy sand throughout, its slopes are more uniform, and it is more stable. Drainage is some-

what excessive. The available water capacity is 2.5 to 4 inches. Runoff is slow. The hazard of water erosion is none to slight, but the hazard of wind erosion is high.

Included with this soil in mapping were small areas of Feltham loamy sand, Tindahay loamy sand, and Vining loamy sand.

This Quincy soil is used mainly for range, but a small acreage is used for beans, wheat, mixed grains, alfalfa hay, and pasture. This soil can be worked throughout a wide range of moisture content. (Capability unit IIIe-73, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

**Quincy loamy sand, 4 to 8 percent slopes (QuC).**—This soil is similar to Quincy sand, 2 to 12 percent slopes, except that it is loamy sand throughout, its slopes are more uniform, and it is more stable. Drainage is somewhat excessive. The available water capacity is 2.5 to 4 inches. Runoff is slow. The hazard of water erosion is none to slight in dryland areas and moderate in irrigated areas. The hazard of wind erosion is high.

Included with this soil in mapping were small areas of Feltham loamy sand, Tindahay loamy sand, and Vining loamy sand.

This Quincy soil is used mainly for range, but a small acreage is used for wheat, mixed grains, alfalfa hay, pasture, and, in a few places, for beans. This soil can be worked throughout a wide range of moisture content. (Capability unit IVe-74, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

## Rock Land

Rock land (Rk) is 50 to 90 percent basalt rock outcrops, but some soil material is interspersed. Slopes are dominantly 4 to 30 percent. The vegetation is big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass.

This land type is used for limited grazing and wildlife habitat. (Capability unit VIIIs-985, nonirrigated; not in a windbreak group)

## Rock Outcrop

This miscellaneous land type consists of basalt rock. Crevices in the rock contain some soil material. The vegetation is moss or lichens. In some areas there are a few inches of soil over the bedrock.

This land type is associated with soils of the Trevino, Minidoka, Portino, Portneuf, Somsen, and Vining series and Rock land.

**Rock outcrop-Trevino complex, 2 to 20 percent slopes (RtE).**—The soils in this complex are very gently sloping to strongly sloping on basalt plains thinly covered with loess. Rock outcrop covers 60 percent of the surface area, and the Trevino soils make up most of the rest.

Included with these soils in mapping were small areas of Kimama, Minidoka, Portino, and Portneuf silt loams and rubble land.

This complex is used mainly for range. (Capability unit VIIIs-970, nonirrigated; not in a windbreak group)

## Schodson Series

The Schodson series consists of very deep, somewhat poorly drained, level or nearly level soils that formed in

stratified, mixed alluvium on low terraces. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Arloval, Decker, Maxey, and Wodskow series.

In a representative profile, the surface layer and upper part of the substratum are brown sandy loam about 25 inches thick. The lower part of the substratum is pale-brown loamy coarse sand that extends to a depth of about 32 inches. Below this is light brownish-gray and light-gray coarse sand to a depth of 50 inches and more. Mottles are below a depth of 25 inches. The soil is slightly limy below a depth of 43 inches.

Schodson soils are used for row crops, hay, and pasture.

**Schodson sandy loam (0 to 2 percent slopes) (Sd).**—This soil is on low terraces. The soil areas are elongated to somewhat rounded and 10 to 100 acres in size.

Representative profile, 15 feet east of fence and 340 feet north of county road, about 1,400 feet northeast of the southeast corner of SE $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 19, T. 9 S., R. 24 E., one-eighth of a mile west of Rupert, in a beanfield where the slope is 0.2 percent.

Ap—0 to 9 inches, brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist, dark grayish brown (10YR 4/2) crushed and moist; very weak, fine and very fine, granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine, interstitial pores; moderately alkaline; abrupt, smooth boundary.

C1—9 to 25 inches, brown (10YR 5/3) sandy loam that has very few pebbles, pale brown (10YR 6/3) crushed, dark brown (10YR 4/3) moist; very weak, medium and coarse, subangular blocky structure parting to very weak, very fine, granular; soft, very friable, nonsticky and nonplastic; few roots; many, very fine, interstitial pores and common, very fine, tubular pores; few pore spaces are slightly calcareous; moderately alkaline; clear, smooth boundary.

IIC2—25 to 32 inches, pale-brown (10YR 6/3) loamy coarse sand, dark grayish brown (10YR 4/2) moist, dark brown (10YR 4/3) crushed and moist; common, fine, distinct, brown (7.5YR 5/2 and 10YR 4/3) mottles that are dark yellowish brown (10YR 4/4) and dark brown (7.5YR 3/2) moist; massive; slightly hard, very friable but few firm peds, nonsticky and nonplastic; very few roots; many, very fine, interstitial pores and common, very fine, tubular pores; 10 percent gravel; moderately alkaline; clear, smooth boundary.

IIC3—32 to 43 inches, light brownish-gray (10YR 6/2) coarse sand, dark grayish brown (10YR 4/2) moist; common, coarse, distinct, brown (7.5YR 5/2 and 10YR 4/3) mottles that are dark yellowish brown (10YR 4/4) and dark brown (7.5YR 3/2) moist; single grain; loose, nonsticky and nonplastic; many, very fine, interstitial pores; 7 percent gravel; moderately alkaline; clear, smooth boundary.

IIC4—43 to 50 inches, light-gray (10YR 6/1) coarse sand, gray (10YR 5/1) moist; few, coarse, distinct mottles; single grain; loose, nonsticky and nonplastic; many, very fine, interstitial pores; saturated with water; slightly calcareous; 7 percent gravel; moderately alkaline.

The Ap horizon ranges from pale brown or brown (10YR 6/3 or 5/3) to light brownish gray or grayish brown (10YR 6/2 or 5/2) in color. In some areas it is slightly calcareous. The upper boundary of the sand is at depths between 20 and 40 inches but is mainly below a depth of 30 to 35 inches. The water table fluctuates between depths of 30 and 40 inches during summer.

Included with this soil in mapping were small areas of Arloval sandy loam, Maxey sandy loam, Wodskow

sandy loam, and a soil that is similar to this Schodson soil but is deep to sand or gravelly sand. Also included were small areas of a soil that is moderately deep to gravelly sand.

This Schodson soil has moderately rapid permeability. The available water capacity is 4.5 to 6.0 inches. Runoff is slow, the hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

This soil is used for sugar beets, corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and pasture. Choice of crops is somewhat limited because of the water table in summer. The soil is easily worked throughout a wide range of moisture content. (Capability unit IIIw-64, irrigated; windbreak group 76)

**Schodson sandy loam, saline** (0 to 2 percent slopes) (Sh).—This soil is similar to Schodson sandy loam, except that it contains soluble salts in amounts that impair plant growth and it is in smaller areas than that soil.

This soil is used for sugar beets, wheat, barley, mixed grains, alfalfa hay, and pasture. (Capability unit IIIw-64, irrigated; windbreak group 74)

**Schodson loamy sand** (0 to 2 percent slopes) (Sc).—This soil is similar to Schodson sandy loam, except that it has a surface layer of loamy sand 8 to 12 inches thick. The hazard of wind erosion is high.

Included with this soil in mapping were saline spots and small areas of Arloval loamy sand, mixed loamy sand, and Schodson sandy loam.

This Schodson soil is used for sugar beets, corn for silage, beans, wheat, mixed grains, barley, hay, and pasture. (Capability unit IIIe-73, irrigated; windbreak group 76)

## Somsen Series

The Somsen series consists of moderately deep, well-drained, level or nearly level to strongly sloping soils that formed in eolian deposits on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, rabbitbrush, needle-and-thread, Indian ricegrass, sod wheatgrass, and cheatgrass. Elevation is 4,150 to 4,300 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Escalante, Kecko, Taunton, and Vining series.

In a representative profile, the surface layer is grayish-brown and light brownish-gray very stony fine sandy loam about 4 inches thick. The subsoil is light brownish-gray very stony fine sandy loam about 5 inches thick. The substratum is light brownish-gray and white very stony fine sandy loam. Basalt bedrock is at a depth of 24 inches. The profile is limy, except in the upper 1½ inches.

Somsen soils are used mainly for range or are idle.

**Somsen-Rock outcrop complex, 2 to 20 percent slopes** (SoE).—The soils of this complex are on loess-covered basalt plains. About 80 percent of this complex consists of Somsen soils that have a surface layer of fine sandy loam, very stony fine sandy loam, or loamy sand. Bedrock outcrops cover about 20 percent of the soil areas. Mapped areas of this complex are long, irregularly shaped, and 10 to 300 acres in size.

Representative profile of Somsen very stony fine sandy loam, 25 feet north of the southwest corner of sec. T. 8 S., R. 26 E., about 2 miles north and 2 miles east of

Minidoka Wildlife Refuge Headquarters, in an area of big sagebrush and grass where the slope is about 2 or 3 percent.

A11—0 to 1½ inches, grayish-brown (10YR 5/2) very stony light fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, non-sticky and nonplastic; many very fine roots; mildly alkaline; abrupt, smooth boundary.

A12—1½ to 4 inches, light brownish-gray (10YR 6/2) very stony fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very thin, platy structure parting to very weak, very fine, granular; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; common, very fine, tubular pores; slightly calcareous; moderately alkaline; abrupt, smooth boundary.

B—4 to 9 inches, light brownish-gray (10YR 6/2) very stony fine sandy loam, brown (10YR 4/3) moist; very weak, coarse, subangular blocky structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine and fine roots; many, very fine, tubular pores and many, very fine, interstitial pores; moderately calcareous; about 15 percent stones and angular cobblestones; moderately alkaline; clear, smooth boundary.

C1ca—9 to 14 inches, light brownish-gray (10YR 6/2) very stony fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common, fine and very fine, tubular pores and many, very fine, interstitial pores; about 20 percent stones and angular cobblestones; moderately calcareous, few very fine veins and splotches of lime and common small pieces of strongly calcareous material from the C2ca horizon; moderately alkaline; clear, wavy boundary.

C2ca—14 to 24 inches, white (10YR 8/2) very stony fine sandy loam, pale brown (10YR 6/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; few, very fine, tubular pores; about 25 percent stones and angular cobblestones; common cicada krotovinas; discontinuous weakly cemented material, about one-half inch thick, on top of bedrock; strongly calcareous; moderately alkaline; abrupt, wavy boundary.

IIR—24 inches, basalt bedrock; lime coatings on surface and in cracks.

The A horizon ranges from light brownish gray or pale brown (10YR 6/2 or 6/3) to grayish brown or brown (10YR 5/2 to 5/3) in color. The soil is sandy loam or fine sandy loam at depths between 10 inches and bedrock. The Cca horizon has an upper boundary at depths between 7 and 16 inches. Bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping were small areas where slopes are less than 2 percent or more than 20 percent and areas of Escalante, Quincy, Taunton, and Vining soils.

This Somsen soil has moderately rapid permeability, and roots penetrate to bedrock. The available water capacity is 3 to 4.5 inches. Runoff is very slow to medium, and the hazard of water erosion is slight to moderate in dryland areas and moderate to very high in irrigated areas. The hazard of wind erosion is slight to moderate.

This soil is used mainly for range. A small acreage is used for irrigated pasture. (Capability unit VIe-55, irrigated; capability unit VIs-841, nonirrigated; not in a windbreak group.)

**Somsen-Vining complex, 2 to 20 percent slopes** (SvE).—This complex is on loess-covered basalt plains. It consists of about 50 percent Somsen fine sandy loam, loamy sand, and very stony fine sandy loam; 40 percent Vining fine sandy loam, loamy sand, and very stony fine sandy

loam; and 10 percent rock outcrops. The soils are in areas so intermingled that they cannot be mapped or used and managed separately. Mapped areas of this complex are generally larger than those of Somsen-Rock outcrop complex, 2 to 20 percent slopes.

Included with these soils in mapping were small areas of Escalante, Kecko, and Quincy soils.

This complex is used for range. (Capability unit VIc-841, nonirrigated; not in a windbreak group)

**Somsen fine sandy loam, 2 to 4 percent slopes (SnB).**—This soil is on the sides of depressions and drainageways. It is similar to Somsen very stony fine sandy loam, except that it has a surface layer of fine sandy loam that is essentially free of stones. Mapped areas of this soil are much smaller than those of Somsen-Rock outcrop complex, 2 to 20 percent slopes. Runoff is slow to medium. The hazard of water erosion is none to slight in dryland areas and moderate in irrigated areas. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Escalante fine sandy loam, Taunton fine sandy loam, and Vining fine sandy loam.

This Somsen soil is used mainly for range or is idle. A small acreage is used for corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and pasture. This soil either is irrigated or has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IIIc-69, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

**Somsen fine sandy loam, 4 to 8 percent slopes (SnC).**—This soil is on sides of drainageways and depressions. It is similar to Somsen very stony fine sandy loam, except that it has a surface layer of fine sandy loam that is essentially free of stones. Mapped areas of this soil are much smaller than those of Somsen-Rock outcrop complex, 2 to 20 percent slopes. Runoff is medium. The hazard of water erosion is only slight in dryland areas but is high in irrigated areas. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Escalante fine sandy loam and Vining fine sandy loam.

This Somsen soil is used mainly for range, or it is idle. A small acreage is used for corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and pasture. This soil either is irrigated or has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IIIc-69, irrigated; capability unit VIc-846, nonirrigated; windbreak group 72)

**Somsen loamy sand, 0 to 4 percent slopes (SmB).**—This soil is on the sides of drainageways and depressions. It is similar to Somsen very stony fine sandy loam, except that it has a surface layer of loamy sand that is essentially free of stones. Mapped areas of this soil are much smaller than those of Somsen-Rock outcrop complex, 2 to 20 percent slopes. Runoff is slow, and the hazard of water erosion is none to slight. The hazard of wind erosion is high.

Included with this soil in mapping were small areas of Kecko loamy fine sand, Feltham loamy sand, and Vining loamy sand.

This Somsen soil is used mainly for range, or it is idle. A small acreage is used for corn for silage, wheat,

mixed grains, barley, alfalfa hay, and pasture. This soil either is irrigated or has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IIIc-73, irrigated; capability unit VIIc-969, nonirrigated; windbreak group 75)

**Somsen loamy sand, 4 to 8 percent slopes (SmC).**—This soil is on the sides of drainageways and depressions. It is similar to Somsen very stony fine sandy loam, except that it has a surface layer of loamy sand that is essentially free of stones. Mapped areas of this soil are much smaller than those of Somsen-Rock outcrop complex, 2 to 20 percent slopes. Runoff is medium. The hazard of water erosion is slight in dryland areas and moderate in irrigated areas. The hazard of wind erosion is high.

This soil mainly is used for range or is idle. A small acreage is used for corn for silage, wheat, mixed grains, barley, alfalfa hay, and pasture. This soil either is irrigated or has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IVc-74, irrigated; capability unit VIIc-969, nonirrigated; windbreak group 75)

## Taunton Series

The Taunton series consists of moderately deep, well-drained, level or nearly level to gently sloping soils that formed in eolian material on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, rabbitbrush, Indian ricegrass, needle-and-thread, Sandberg bluegrass, and cheatgrass. Elevation is 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Quincy and Vining series.

In a representative profile, the surface layer is light brownish-gray light sandy loam about 3 inches thick. The subsoil is pale-brown light sandy loam that extends to a depth of 13 inches. The upper part of the substratum is very pale brown light sandy loam that extends to a depth of 20 inches. Below this is a white hardpan strongly cemented with lime and silica.

Taunton soils are used mainly for range. Some small areas have been irrigated and are used for row crops, hay, and pasture.

**Taunton sandy loam, 2 to 4 percent slopes (TcB).**—This soil is on slightly convex ridges on loess-covered basalt plains. The soil areas are irregularly shaped and elongated or somewhat oval and 15 to 100 acres in size.

Representative profile, 1,400 feet east and 500 feet south of the northeast corner of the SW¼ sec. 27, T. 8 S., R. 25 E., 2½ miles northeast of Acequia and 1½ miles east of railroad, in a noncultivated area where the slope is 2 percent.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) light sandy loam, dark grayish brown (10YR 4/2) moist; very weak, very thin, platy structure parting to very weak, very fine, granular; slightly hard, very friable, nonsticky and nonplastic; many fine and very fine roots; many, very fine, interstitial pores; mildly alkaline; abrupt, smooth boundary.

B—3 to 13 inches, pale-brown (10YR 6/3) light sandy loam, brown to dark brown (10YR 4/3) moist; very weak, fine and medium, subangular blocky structure;

slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; many, very fine, interstitial pores; many gravel-size pieces of hardpan; slightly calcareous; moderately alkaline; clear, smooth boundary.

C1ca—13 to 20 inches, very pale brown (10YR 7/3) light sandy loam, brown (10YR 5/3) moist; very weak, fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; many, very fine, interstitial pores; few to many cobblestones and coarse gravel-size pieces of hardpan; moderately calcareous to strongly calcareous; moderately alkaline; clear, wavy boundary.

C2casim—20 to 30 inches, white (10YR 8/2) hardpan strongly cemented with lime and silica; common horizontal cracks contain soil material; fewer cracks with increasing depth.

The A horizon ranges from grayish brown to light brownish gray (10YR 5/2 to 6/2) in color. The B horizon is slightly calcareous to noncalcareous. The upper boundary of the ca horizon is at depths between 9 and 15 inches, but it is exposed in places. Depth to the C2casim horizon ranges from 20 to 40 inches. Bedrock is below the hardpan at a depth of 24 inches or more.

Included with this soil in mapping were areas of soils that have a surface layer of loamy sand and small areas of Escalante sandy loam, Somsen sandy loam, and Quincy sand. Also included were areas of Taunton soils that have slopes of 0 to 2 percent.

This soil has moderately rapid permeability, and roots penetrate to the hardpan. The available water capacity is 2.5 to 5 inches. In dryland areas, runoff is slow and the hazard of water erosion is none to slight. In irrigated areas, runoff is slow to medium and the hazard of water erosion is moderate. The hazard of wind erosion is slight.

This soil is used mainly for range, but in irrigated areas it is used for corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and pasture. This soil can be worked throughout a wide range of moisture content. (Capability unit IIIE-69, irrigated; capability unit VIc-835, nonirrigated; windbreak group 71)

## Tindahay Series

The Tindahay series consists of very deep, well-drained, level or nearly level soils that formed in mixed alluvium on low terraces. The vegetation is big sagebrush, Indian ricegrass, and needle-and-thread. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Feltham, Quincy, and Schodson series.

In a representative profile, the surface layer is pale-brown sandy loam about 8 inches thick. The upper part of the substratum is pale-brown sandy loam that extends to a depth of 23 inches. The lower part of the substratum is light brownish-gray loamy coarse sand that extends to a depth of 27 inches. Below this is light-gray gravelly coarse sand.

Tindahay soils are used for row crops, hay, and pasture.

**Tindahay sandy loam** (0 to 2 percent slopes) (Th).—This soil is on low terraces. Slopes are mainly less than 1 percent. Immediately north and east of Rupert,

the soil areas are large and irregularly shaped to somewhat rounded, but farther north, near Acequia, they are smaller and oblong. They range from 5 to 3,000 acres in size.

Representative profile, 130 feet south and 40 feet east of the northwest corner of the SW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 15, T. 9 S., R. 24 E., 1.75 miles north of Rupert, in a beanfield where the slope is 0.25 percent.

Ap—0 to 8 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; very weak, very fine and fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; common, very fine, interstitial pores; 5 percent pebbles; mildly alkaline; abrupt, smooth boundary.

C1—8 to 18 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; many, very fine, tubular and interstitial pores; slightly more clay in lower 3 inches; 5 percent pebbles; mildly alkaline; clear, smooth boundary.

C2—18 to 23 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; many, very fine, interstitial and tubular pores; 5 percent pebbles; moderately alkaline; clear, smooth boundary.

IIC3—23 to 27 inches, light brownish-gray (10YR 6/2) loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; few fine and very fine roots; many, very fine, interstitial and tubular pores; 5 percent pebbles; moderately alkaline; clear, smooth boundary.

IIIC4—27 to 60 inches, light-gray (10YR 6/1) gravelly coarse sand, dark gray (10YR 4/1) moist; single grain; loose, nonsticky and nonplastic; few fine roots; thin lime coatings on bottoms of coarse pebbles at a depth below 40 inches; 30 percent gravel; moderately alkaline.

The A horizon ranges from pale brown or brown (10YR 6/3 or 5/3) to light brownish gray or grayish brown (10YR 6/2 or 5/2) in color. It is light loam in some places. By weighted average, the soil at depths between 10 and 40 inches is loamy sand or loamy coarse sand.

Included with this soil in mapping were small areas of Feltham sandy loam, Schodson sandy loam, and a soil that is less than 20 inches deep to very gravelly sand.

This Tindahay soil has moderately rapid permeability. The available water capacity is 4.5 to 5.5 inches. Runoff is slow, and there is no hazard of water erosion. The hazard of wind erosion is slight.

This soil is used for beans, wheat, mixed grains, alfalfa hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIIE-53, irrigated; windbreak group 75)

**Tindahay loamy sand** (0 to 2 percent slopes) (Td).—This soil is similar to Tindahay sandy loam, except that it has a surface layer of loamy sand. The hazard of wind erosion is high.

Included with this soil in mapping were small areas of Feltham loamy sand.

This Tindahay soil is used for beans, wheat, mixed grains, hay, pasture, and range. (Capability unit IIIE-73, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

## Trevino Series

The Trevino series consists of shallow, well-drained, very gently sloping to strongly sloping soils that formed in thin loess deposits on basalt plains. In areas that are not cultivated, the vegetation is big sagebrush, bluebunch wheatgrass, Sandberg bluegrass, and weeds. Elevation is 4,200 to 4,400 feet, and the average annual precipitation is 8 to 11 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Minidoka, Portino, and Portneuf series.

In a representative profile, the surface layer is pale-brown silt loam about 3 inches thick. The subsoil is pale-brown silt loam about 8 inches thick. The substratum is pale-brown stony loam. Basalt bedrock is at a depth of 15 inches. The soil is limy. It is about 20 percent basalt fragments below a depth of 11 inches.

Trevino soils are used mainly for range or remain idle.

**Trevino-Rock outcrop complex, 2 to 20 percent slopes (TrE).**—The soils of this complex are on basalt plains that are thinly covered with loess. Trevino silt loam and stony silt loam make up about 80 percent of the acreage, and Rock outcrops most of the rest. Mapped areas of this complex are generally long and irregularly shaped and about 15 to 300 acres in size.

Representative profile of Trevino silt loam, 1,480 feet north and 130 feet east of the southwest corner of sec. 2, T. 9 S., R. 23 E., 3 miles west and 4.25 miles north of Rupert, in a dryland pasture where the slope is 2 percent.

A1—0 to 3 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; very weak, thin and medium, platy structure parting to weak, very fine and fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; neutral; clear, smooth boundary.

B1—3 to 7 inches, pale-brown (10YR 6/3) silt loam, brown to dark brown (10YR 4/3) moist; very weak, fine and medium, subangular blocky structure parting to weak, very fine and fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine, interstitial pores; neutral; clear, smooth boundary.

B2—7 to 11 inches, pale-brown (10YR 6/3) silt loam, brown to dark brown (10YR 4/3) moist; weak, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, tubular and interstitial pores; neutral; abrupt, smooth boundary.

Cca—11 to 15 inches, pale-brown (10YR 6/3) stony loam, brown (10YR 5/3) moist; massive; 20 percent basalt fragments, ½ to 6 inches in diameter and ¼ to 1 inch thick, that have lime coatings on underside of peds and in pores; roots matted on surface of basalt fragments and between fragments; moderately calcareous; mildly alkaline; abrupt, wavy boundary.

IIR—15 inches, basalt bedrock; lime coatings along upper boundary.

The A horizon ranges from pale brown or brown (10YR 6/3 or 5/3) to light brownish gray or grayish brown (10YR 6/2 or 5/2) in color. A layer of moderate lime accumulation has an upper boundary at depths between 10 and 13 inches. Depth to bedrock ranges from 10 to 20 inches.

Included with this soil in mapping were small areas of Kimama, Minidoka, Portino, and Portneuf soils.

This Trevino soil has moderate permeability above the bedrock, and roots penetrate to the bedrock. The

available water capacity is 2 to 3 inches. Runoff is slow to medium, and the hazard of water erosion is only slight to moderate in dryland areas but is moderate to very high in irrigated areas. The hazard of wind erosion is none to slight.

This soil is used mainly for range, but small areas are within irrigated pasture. The soil is easily worked throughout a fairly wide range of moisture content. (Capability unit VIe-55, irrigated; capability unit VIs-841, nonirrigated; not in a windbreak group)

**Trevino-Portneuf complex, 2 to 20 percent slopes (TrE).**—This complex is on basalt plains. It consists of 60 percent Trevino silt loam, 20 percent Portneuf silt loam, 10 percent Portino silt loam, and 10 percent rock outcrops. The soils and rock outcrops of this complex are so intermingled that they cannot be mapped or used and managed separately. The Portneuf soil is similar to Portneuf silt loam, 0 to 2 percent slopes, except that it is very gently sloping to strongly sloping and is on sides of drainageways and depressions. The Portino soil is similar to Portino silt loam, 2 to 4 percent slopes, except that the slope ranges from 2 to 20 percent. Mapped areas of this complex are about the same general shape and size as those of Trevino-Rock outcrop complex, 2 to 20 percent slopes.

Included with this complex in mapping were small areas of Kimama and Minidoka silt loams.

Runoff is slow to rapid. The hazard of water erosion is slight to moderate, and the hazard of wind erosion is none to slight.

This complex is used principally for range. (Capability unit VIs-841, nonirrigated; not in a windbreak group)

## Vining Series

The Vining series consists of moderately deep, well-drained, level or nearly level to strongly sloping soils that formed in eolian deposits on basalt uplands. In areas that are not cultivated, the vegetation is big sagebrush, rabbitbrush, sod wheatgrass, Indian ricegrass, and cheatgrass. Elevation is 4,150 to 4,300 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 120 to 130 days. Associated are soils of the Taunton, Kecko, Quincy, and Somsen series.

In a representative profile, the surface layer is light brownish-gray very stony fine sandy loam about 4 inches thick. The subsoil is brown very stony fine sandy loam that extends to a depth of 13 inches. The substratum is pale-brown very stony sandy loam. Basalt bedrock is at a depth of 27 inches and is coated with lime on the surface and in the cracks.

Vining soils are used mainly for range, but some of the acreage is used for row crops, hay, and pasture.

**Vining and Somsen soils and Rock outcrop, 2 to 20 percent slopes (VsE).**—This undifferentiated group is on loess-covered basalt uplands. It consists of Vining and Somsen fine sandy loam, loamy sand, and very stony fine sandy loam and Rock outcrop. In most mapped areas, this unit consists of Rock outcrop and either the Vining or the Somsen soil, but in some both Vining and Somsen soils are major components. The components are

so intermingled that they cannot be used or managed separately. One of the Vining soils has the profile described as representative of the Vining series. The mapping unit is in areas that are generally long and irregularly shaped and about 80 to 2,000 acres in size.

Representative profile of Vining very stony fine sandy loam, 2,640 feet east and 660 feet north of the southwest corner of the SW $\frac{1}{4}$  sec. 27, T. 8 S., R. 26 E., 25 feet north of the road, in an area of big sagebrush and grass where the slope is 2 percent.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) very stony fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very thin, platy structure parting to very weak, very fine, granular; slightly hard, very friable, nonsticky and nonplastic; many very fine roots and common fine roots; many, very fine, interstitial pores and few, very fine and fine, tubular pores; neutral; clear, smooth boundary.

B1—4 to 7 inches, brown (10YR 5/3) very stony fine sandy loam, pale brown (10YR 6/3) crushed, very dark grayish brown (10YR 3/2) moist, dark grayish brown (10YR 4/2) crushed and moist; very weak, coarse and medium, prismatic structure parting to very weak, medium, subangular blocky and then to very weak, very fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; many, very fine, interstitial pores and few, very fine, tubular pores; about 5 percent basaltic stones and angular cobblestones; neutral; clear, smooth boundary.

B2—7 to 13 inches, brown (10YR 5/3) very stony fine sandy loam, pale brown (10YR 6/3) crushed, dark brown (10YR 3/3) moist, dark grayish brown (10YR 4/2) crushed and moist; very weak, coarse and medium, subangular blocky structure parting to very weak, very fine, granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots, few fine roots, and very few medium and coarse roots; many, very fine, interstitial pores and few, very fine, tubular pores; about 5 percent basaltic stones and angular cobblestones; neutral; clear, smooth boundary.

C—13 to 27 inches, pale-brown (10YR 6/3) very stony sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few fine and medium roots; many, very fine, interstitial pores and common, very fine, tubular pores; about 20 percent basaltic stones, angular cobblestones, and angular pebbles; few firm cicada krotovinas; mildly alkaline; abrupt, wavy boundary.

IIR—27 inches, basalt bedrock; lime coatings on surface and in pores; calcareous material in cracks.

The A horizon ranges from light brownish gray or pale brown (10YR 6/2 or 6/3) to grayish brown or brown (10YR 5/2 or 5/3) in color. The soil is very stony fine sandy loam and sandy loam at depths between 10 inches and bedrock and contains few to about 25 percent rock fragments. The depth to bedrock ranges from 20 to 40 inches. Depth to lime, which commonly occurs on or just above the bedrock, ranges from 18 to 40 inches.

Included with this soil in mapping were small areas of Feltham, Kecko, and Quincy soils.

This Vining soil has moderately rapid permeability, and roots penetrate to bedrock. The available water capacity is 2.5 to 5 inches. Runoff is slow to medium, and the hazards of water and wind erosion are slight to moderate.

These soils are used for range. (Capability unit VIIIs-970, nonirrigated; not in a windbreak group)

**Vining-Rock outcrop complex, 2 to 20 percent slopes (VrE).**—This complex consists of 80 percent Vining fine sandy loam, loamy sand, and very stony fine sandy loam

and 20 percent Rock outcrop. Mapped areas of this complex are generally 80 to 300 acres in size. The hazard of water erosion is moderate to very high in irrigated areas and is slight to moderate in dryland areas. The hazard of wind erosion is slight to moderate.

This complex is used mainly for range, but a small acreage is included in irrigated pasture. (Capability unit VIe-55, irrigated; capability unit VIs-841, nonirrigated; not in a windbreak group)

**Vining-Quincy complex, 2 to 20 percent slopes (VoE).**—This complex occurs on loess-covered basalt plains. It consists of 60 percent Vining fine sandy loam, loamy sand, and very stony fine sandy loam; 30 percent Quincy sand; and 10 percent rock outcrops. The soils and rock outcrops of this complex are so intermingled that they cannot be mapped or used and managed separately. Mapped areas of this complex are generally 40 to 100 acres in size. The hazard of wind erosion is very high.

This soil is used for range. (Capability unit VIIe-969, nonirrigated; not in a windbreak group)

**Vining fine sandy loam, 2 to 4 percent slopes (VnB).**—This soil is on the sides of drainageways and depressions. It is similar to Vining very stony fine sandy loam, except that it has a surface layer mainly of fine sandy loam and is essentially free of stones. Mapped areas of this soil are about 20 to 50 acres in size. Runoff is slow to medium. The hazard of water erosion is none to slight in dryland areas and is moderate in irrigated areas. The hazard of wind erosion is slight.

Included with this soil in mapping were small areas of Kecko fine sandy loam, Somsen fine sandy loam, and Vining loamy sand.

This Vining soil is used mainly for range, but a small acreage is used for corn for silage, beans, wheat, mixed grains, barley, alfalfa hay, and pasture. The soil either is irrigated or has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IIIe-69, irrigated; capability unit VIe-835, nonirrigated; windbreak group 71)

**Vining loamy sand, 0 to 4 percent slopes (VIB).**—This soil is on the sides of drainageways and depressions. It is similar to Vining very stony fine sandy loam, except that it has a surface layer mainly of loamy sand and is essentially free of stones. Mapped areas of this soil are 80 to 200 acres in size. Runoff is slow. The hazard of water erosion is none to slight, but the hazard of wind erosion is high.

Included with this soil in mapping were small areas of Feltham loamy sand, Kecko loamy sand, and Somsen loamy sand.

This Vining soil is used mainly for range, but a small acreage is used for corn for silage, wheat, mixed grains, barley, alfalfa hay, and pasture. This soil either is irrigated or has a potential for irrigation. It can be easily worked throughout a wide range of moisture content. (Capability unit IIIe-73, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

**Vining loamy sand, 4 to 8 percent slopes (VIC).**—This soil is on the sides of drainageways and depressions. It is similar to Vining very stony fine sandy loam, except that it has a surface layer mainly of loamy sand and is essentially free of stones. Mapped areas of this soil are 40 to 80 acres in size. Runoff is medium. The hazard of

water erosion is slight in dryland areas and moderate in irrigated areas. The hazard of wind erosion is high.

This soil is used mainly for range, but a small acreage is used for corn for silage, beans, wheat, mixed grains, barley, hay, and pasture. This soil has a potential for irrigation. It can be worked throughout a wide range of moisture content. (Capability unit IVe-74, irrigated; capability unit VIIe-969, nonirrigated; windbreak group 75)

## Wheeler Series

The Wheeler series consists of deep and very deep, well-drained, sloping to moderately steep soils that formed in loess deposits on basalt plains. In areas that are not cultivated, the vegetation is mostly big sagebrush, winterfat, needle-and-thread, and cheatgrass. Elevation is 4,150 to 4,200 feet, and the average annual precipitation is 8 to 10 inches. Average annual temperature is 48° F., and the frost-free season is 125 to 130 days. Associated are soils of the Escalante, Portneuf, and Trevino series.

In a representative profile, the surface layer is light brownish-gray silt loam about 4 inches thick. The substratum is light-gray silt loam to a depth of 38 inches. Below this is very pale brown silt loam that reaches to a depth of 66 inches. These soils are limy throughout.

Wheeler soils are used for row crops, hay, pasture, and range, or they are idle.

**Wheeler silt loam, 12 to 30 percent slopes (WhF).**—This soil is on the sides of distinct drainageways or low terraces and in places is on the leeward side of low buttes. The soil areas are generally elongated and somewhat irregularly shaped and 10 to 160 acres in size.

Representative profile, 200 feet south and 200 feet west of the northeast corner of the SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 12, T. 9 S., R. 22 E., 1.5 miles west and 3.5 miles north of Paul, in an idle area where the slope is 15 percent.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; very weak, medium and thick, platy structure; slightly hard, very friable, slightly sticky and slightly plastic; plentiful very fine roots; few, very fine, tubular and interstitial pores; moderately calcareous; moderately alkaline; clear, smooth boundary.

C1—4 to 16 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; weak, very coarse, prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots and few fine roots, many grow along ped faces; few, very fine, tubular pores; moderately calcareous or strongly calcareous; moderately alkaline; gradual, smooth boundary.

C2—16 to 38 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; very weak prismatic structure parting to very weak blocky; slightly hard, very friable, slightly sticky and slightly plastic; few medium roots, concentrated between peds; few very hard cicada krotovinas that have very thin lime coatings on surface; moderately alkaline; gradual, smooth boundary.

C3—38 to 66 inches, very pale brown (10YR 7/3) silt loam that is high in content of coarse silt, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few, very fine, tubular pores; moderately calcareous to strongly calcareous; strongly alkaline.

The A horizon is generally light brownish gray (10YR 6/2) ranging to pale brown (10YR 6/3) or grayish brown (10YR 5/2), but in places it is lacking. Depth to bedrock is generally

more than 60 inches but in some areas is as little as 40 inches.

Included with this soil in mapping were small areas of Portneuf silt loam and a soil that is similar to this Wheeler soil but is less than 40 inches deep to bedrock.

This soil has moderate permeability, and roots penetrate easily. The available water capacity is 8 to 12 inches. Runoff is rapid, the hazard of water erosion is high, and the hazard of wind erosion is none to slight.

This soil is used for range or is idle. It can be worked throughout a fairly wide range of moisture content. (Capability unit VIIe-975, nonirrigated; not in a windbreak group)

**Wheeler silt loam, 8 to 12 percent slopes (WhD).**—This soil is on the sides of drainageways or low terraces. It is similar to Wheeler silt loam, 12 to 30 percent slopes, except that it is sloping. Also, it is in areas that are less elongated and generally are 10 to 80 acres in size. Runoff is medium. The hazard of water erosion is very high in irrigated areas and moderate in dryland areas. The hazard of wind erosion is none to slight.

This soil is used mainly for range or is idle, but a small acreage is used for wheat, mixed grains, barley, alfalfa hay, and pasture. (Capability unit IVe-50, irrigated; capability unit VIe-846, nonirrigated; not in a windbreak group)

## Wodskow Series

The Wodskow series consists of very deep, somewhat poorly drained, level or nearly level soils that formed in stratified alluvium that is of mixed mineralogy and that has been influenced by eolian deposition. Depth to the water table fluctuates between 30 and 40 inches in summer. Elevation is about 4,150 feet, and the average annual precipitation is 9 to 10 inches. Average annual temperature is 48° F., and the frost-free season is about 130 days. Associated are soils of the Abo, Decker, and Maxey series.

In a representative profile, the surface layer is grayish-brown sandy loam about 12 inches thick. The subsoil is light brownish-gray and pale-brown sandy loam that extends to a depth of 28 inches. Below this, the substratum is white loam to a depth of 34 inches, light-gray sandy loam to a depth of 40 inches, and light-gray loamy sand to a depth of 55 inches. An unconformable layer of coarse sand is between depths of 55 and 60 inches. The profile is mottled below a depth of 12 inches and is limy, except between depths of 8 and 12 inches.

Wodskow soils are used for row crops, hay, and pasture.

**Wodskow sandy loam (0 to 2 percent slopes) (Wk).**—This soil is in flat or slightly convex areas on low terraces. The soil areas are somewhat round to oblong and irregularly shaped. They are 5 to 100 acres in size.

Representative profile, 390 feet east and 511 feet north of the southwest corner of the SE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 32, T. 9 S., R. 24 E., about 0.5 mile south of Rupert, in a beanfield where the slope is 0.3 percent.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) sandy loam, brown (10YR 5/3) crushed, dark grayish brown (10YR 4/2) moist; very weak, medium and fine, subangular blocky structure parting to very weak, fine, granular; slightly hard, very friable, nonsticky and

- nonplastic; common very fine and fine roots; many, very fine, interstitial pores and common, very fine, tubular pores; slightly calcareous; mildly alkaline; abrupt, smooth boundary.
- A12—8 to 12 inches, grayish-brown (10YR 5/2) sandy loam, brown (10YR 5/3) crushed, dark grayish brown (10YR 4/2) moist; very weak, medium and fine, subangular blocky structure parting to very weak, fine, granular; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine, interstitial pores and common, very fine, tubular pores; noncalcareous; abrupt, smooth boundary.
- B1—12 to 20 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; few, fine and medium, distinct, brown (10YR 5/3) mottles that are dark brown (7.5YR 3/2) moist; very weak, medium and fine, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many, very fine, interstitial pores and many, very fine and fine, tubular pores; very slightly calcareous, few spots and veins of lime; mildly alkaline; clear, smooth boundary.
- B2—20 to 28 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; few, fine, distinct mottles that are dark brown (7.5YR 3/2) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, tubular pores and many, very fine, interstitial pores; few worm channels; very slightly calcareous, few fine veins of lime, mainly in the upper 2 inches; mildly alkaline; clear, smooth boundary.
- C1ca—28 to 34 inches, white (10YR 8/1) loam, light brownish gray (10YR 6/2) moist; very fine, distinct, pale-brown (10YR 6/3) mottles that are dark yellowish brown (10YR 4/4) and brown (10YR 5/3) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine roots; many, very fine, tubular pores; few  $\frac{1}{2}$ - to  $\frac{3}{4}$ -inch krotovinas of soil material from the B2 horizon; strongly calcareous, common fine veins and splotches of lime; moderately alkaline; clear, smooth boundary.
- C2ca—34 to 40 inches, light-gray (10YR 7/1) sandy loam, grayish brown (10YR 5/2) moist; few, fine and medium, distinct, grayish-brown (10YR 5/2) and dark grayish brown (10YR 4/2) mottles that are dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) moist; very weak, medium and coarse, subangular blocky structure but thick platy structure in upper inch; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common, very fine, tubular pores; 7 percent firm cicada krotovinas; strongly calcareous, very few fine veins and splotches of lime; moderately alkaline; clear, smooth boundary.
- C3ca—40 to 55 inches, light-gray (10YR 7/2) loamy fine sand, grayish brown (10YR 5/2) moist; few, fine and medium, distinct mottles that are dark brown (7.5YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; very few roots; many, very fine, interstitial pores; discontinuous lenses, about  $\frac{1}{2}$  inch thick, of very weakly cemented sandy loam; moderately calcareous; moderately alkaline; clear, smooth boundary.
- IIC4—55 to 60 inches, coarse sand; single grain; loose; saturated with water.

The A horizon ranges from grayish brown or brown (10YR 5/2 or 5/3) to light brownish gray or pale brown (10YR 6/2 or 6/3) in color. The soil material averages sandy loam at depths between 10 and 40 inches. The depth to a strongly calcareous layer ranges from 18 to 32 inches, and some layer above the strongly calcareous layer is noncalcareous. In some areas, depth to the IIC4 horizon is as little as 40 inches, and in some areas the horizon is gravelly.

Included with this soil in mapping were small areas of Decker sandy loam, Schodson sandy loam, and Maxey

loamy fine sand and fairly large areas of Wodskow loamy sand. Also included were spots where the soils have a moderately calcareous to strongly calcareous surface layer as a result of cutting or filling during land-leveling operations.

This Wodskow soil has moderate permeability. The available water capacity is 5 to 7 inches. Runoff is slow, the hazard of water erosion is none to slight, and the hazard of wind erosion is slight.

This soil is used for sugar beets, beans, corn for silage, wheat, mixed grains, barley, alfalfa hay, and pasture. It can be worked throughout a wide range of moisture content. (Capability unit IIw-72, irrigated; windbreak group 76)

**Wodskow sandy loam, saline** (0 to 2 percent slopes) (Wo).—This soil has a profile similar to the one described as representative of the series except that it contains soluble salts in amounts that impair plant growth.

This soil is used for sugar beets, wheat, mixed grains, barley, alfalfa hay, and pasture. (Capability unit IIIw-64, irrigated; windbreak group 74)

## Use and Management of the Soils

This section describes the general management practices that apply to all cultivated soils in the Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties. It explains the system of capability grouping used by the Soil Conservation Service, describes the capability units in the survey area, and gives suggestions for use and management of soils in each unit. Estimated yields of the principal crops are shown. Also discussed is use of soils for windbreaks and for wildlife. The properties and features that affect use of the soils for engineering are listed mainly in tables.

## General Management Practices

Precise statements about soils in the Minidoka Area and predictions about their use and management can best be made about individual mapping units. However, broad generalizations can be made for groups of soils and about management practices.

Crop rotations that are suited to the soils and the climate and that include suitable crops help to sustain production over a long period of time. Grasses and legumes improve the soil by furnishing organic matter, improving structure, and adding nitrogen. In their natural states Portino and Portneuf soils, the most extensive soils in the Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties, generally have less than 1 percent organic matter in the surface layer. Unless all residues are returned to the soil, row crops tend to deplete organic matter because repeated tillage of soil is required. Organic matter not only provides a source of plant nutrients but also is the chief contributor to good soil structure. Green manure and barnyard manure help to maintain organic-matter content and structure. Commercial fertilizers also help to increase the amounts of crop residues and thus help to maintain or improve organic-matter content and tilth.

Tillage is generally necessary for seedbed preparation, but excessive tillage can destroy favorable structure, accelerate oxidation of organic matter, and compact the soil. Some soils, such as Paulville clay loam, that have a moderately fine textured surface layer become puddled and excessively cloddy if worked at a high moisture content. Other sandy soils such as Quincy loamy sand, can be eroded by wind as a result of excessive tillage. On these soils, leaving the surface rough and the crop residue on the surface helps to control wind erosion.

Management of irrigation water should conserve soil and water as well as maintain moisture in the root zone. The soil texture, the slope, and choice of crop, and the water supply are things to consider when deciding on a method of irrigation. Such soils as those of the Quincy series hold relatively small amounts of water and require short runs and light, frequent applications of irrigation water. Such soils as those of the Paulville series take in water slowly but hold large amounts of it, and they require less frequent irrigation. Such sloping soils as Portneuf silt loam, 8 to 12 percent slopes, are very highly erodible and require special care to minimize the hazard.

Most soils in the Minidoka Area are low in nitrogen and available phosphorus. Alfalfa responds to applications of phosphate; most other crops respond to both nitrogen and phosphate; and beans respond to small applications of zinc when grown in soils that are calcareous at or near the surface.

## Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, trees, or engineering purposes.

In the capability system, all kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These levels are discussed in the following paragraphs.

**CAPABILITY CLASSES**, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (No class I soils in the Minidoka Area.)

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat. (No class V soils in the Minidoka Area.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial production of crops and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

**CAPABILITY UNITS** are soil groups within the subclass. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are designated by adding an Arabic numeral to the subclass symbol, for example, IIe-50 or IIIe-52. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

## Management by Capability Units

In the following pages, the capability units in the Minidoka Area are described and suggestions for the use and management of the soils are given.

Capability units are identified by numbers assigned locally and are part of a statewide, or larger, system.

Because the soils of this Area are not representative of all the units in the system used by Idaho, the capability units in this survey are not numbered consecutively.

The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils in a given series are in the unit. To find the capability unit in which a given mapping unit has been placed, see the "Guide to Mapping Units."

#### **CAPABILITY UNIT IIe-50, IRRIGATED**

This unit consists of very gently sloping, deep or very deep, well-drained soils of the Declo, Escalante, Kecko, and Portneuf series. These soils have textures of loam, silt loam, or fine sandy loam. Permeability is moderate or moderately rapid. Available water capacity is 7 to 12 inches. Runoff is slow to medium, and during irrigation the hazard of water erosion is moderate. The hazard of wind erosion is slight. The frost-free season is 120 to 130 days.

Sugar beets, potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 3 years of alfalfa or alfalfa and grass; 1 or 2 years of potatoes, sugar beets, or beans; 1 year of grain; 1 year of potatoes, beets, or beans; and then 1 year of grain and a new seeding of alfalfa or grass.

Water erosion can be controlled by giving careful attention to the rate at which irrigation water is applied and to the length of the run. Because their available water capacity is slightly lower, the Kecko and Escalante soils in this unit need more frequent irrigation than the Declo and Portneuf soils. Wind erosion that occurs during seedbed preparation in spring can be controlled by keeping tillage to a minimum, using manure and crop residue, and including close-growing crops at regular intervals in the cropping system.

Deep cuts should be avoided when leveling these soils, but where deep cuts already have been made, manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops. Areas less extensively cut generally can be improved by seeding them to a grass-legume mixture and applying relatively large amounts of commercial fertilizers.

#### **CAPABILITY UNIT IIe-51, IRRIGATED**

This unit consists of very gently sloping, moderately deep, well-drained soils of the Minidoka and Portino series. These soils have a surface layer of silt loam and are underlain by a caliche hardpan or by bedrock. Permeability is moderate. Available water capacity is generally 5 to 7.5 inches, but in places it is as low as 4.5 inches. Runoff is medium, and the hazard of water erosion is moderate. The frost-free season is about 125 days.

Sugar beets, potatoes, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 1 year of grain and a new seeding of alfalfa and grass, 3 or 4 years of alfalfa-grass hay, 1 year of potatoes or sugar beets, 1 year of grain, and then another year of potatoes or sugar beets. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated because their available water capacity is only fair. Water erosion can be controlled by paying careful attention to the rate at which water is applied and to the length of the run. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by minimum tillage.

Deep cuts should be avoided when leveling these soils, but where deep cuts already have been made, manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops. Areas less extensively cut generally can be improved by seeding them to a grass-legume mixture and applying relatively large amounts of commercial fertilizer.

#### **CAPABILITY UNIT IIw-72, IRRIGATED**

This unit consists of level and nearly level, deep and very deep, somewhat poorly drained soils of the Abo, Arloval, Decker, and Wodskow series. These soils have a surface layer of fine sandy loam, loamy fine sand, sandy loam, or loam and are underlain by material that ranges from loamy fine sand to light clay loam. Permeability is moderately slow to rapid. Available water capacity is 5 to 10 inches. Runoff is slow or very slow, the hazard of water erosion is none or slight, and the hazard of wind erosion is slight or high. A few small areas are slightly to moderately saline and are shown on the soil map by a spot symbol. The frost-free season is about 130 days.

Sugar beets, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops. A suitable cropping system for the soils in this unit is 2 to 4 years of red clover or alfalfa-grass hay, 1 year of grain, 1 or 2 years of sugar beets or beans, and then 1 year of grain and a new seeding of alfalfa and grass. Corn for silage (fig. 7) and irrigated grass-legume pasture also work well in the cropping system.

Soils in this unit are irrigated by the border, corrugation, or furrow method. Because a high water table in summer is a limitation, only water-tolerant crops can be grown. Wind erosion can be controlled by planting field windbreaks, using minimum tillage, using manure and crop residue, and maintaining a plant cover on the soils.

#### **CAPABILITY UNIT IIe-55, IRRIGATED**

This unit consists of level and nearly level, moderately deep, well-drained soils of the Minidoka and Portino series. These soils have a surface layer of silt loam and are underlain by a caliche hardpan or by bedrock. Permeability is moderate. Available water capacity is generally about 5 to 7.5 inches, but in places it is as low as 4 inches. Runoff is slow, and the hazard of water erosion is none to slight. The frost-free season is about 125 days.

Potatoes, sugar beets, wheat, mixed grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system is 1 year of grain and a new seeding of alfalfa and grass, 2 or 3 years of alfalfa-grass hay, and 2 years of potatoes or sugar beets.

Soils in this unit are irrigated by the corrugation, furrow, border, or sprinkler method. They need moderately frequent irrigation because their available water capacity is only fair. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by use of minimum tillage.



**Figure 7.**—An exceptionally good stand of corn grown for silage. The soil is Wodskow sandy loam, which is in capability unit IIw-72, irrigated.

Deep cuts should be avoided when leveling these soils, but where deep cuts already have been made, manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops. Areas less extensively cut can be improved by seeding them to a grass-legume mixture and applying relatively large amounts of commercial fertilizer.

#### **CAPABILITY UNIT IIc-50, IRRIGATED**

This unit consists of level and nearly level, deep and very deep, well-drained soils of the Clems, Declo, Escalante, Kecko, Kimama, Paulville, and Portneuf series. These soils have a surface layer of silt loam, fine sandy loam, loam, clay loam, and sandy loam and are underlain mainly by loam and silt loam, but in places by fine sandy loam and sandy loam. Permeability is moderately rapid to moderately slow in the subsoil. Available water capacity is 7 to 12 inches. Runoff is slow or very slow, and the hazards of wind and water erosion are none to slight. The frost-free season is 120 to 130 days.

Sugar beets, potatoes (fig. 8), beans, wheat, mixed small grains (fig. 9), alfalfa hay, and pasture are the major crops and are generally grown in rotation. Potatoes are

generally not grown on Paulville clay loam. A typical cropping system for the soils in this unit consists of 3 years of alfalfa or alfalfa and grass; 2 or 3 years of potatoes, sugar beets, or beans; 1 year of grain; and 1 year of a new seeding of alfalfa, grass, or both for use as hay. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated by the border, corrugation, or furrow method. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by using minimum tillage, barnyard manure, and crop residue.

Deep cuts should be avoided when leveling these soils, but where deep cuts already have been made, manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops. Areas less extensively cut generally can be improved by seeding them to a grass-legume mixture and applying relatively large amounts of commercial fertilizer.

#### **CAPABILITY UNIT IIIc-50, IRRIGATED**

This unit consists of gently sloping, very deep, well-drained soils of the Declo, Escalante, and Portneuf series.



**Figure 8.**—An excellent stand of Idaho Russet potatoes. The soil is Portneuf silt loam, 0 to 2 percent slopes, which is in capability unit IIc-50, irrigated.

These soils have a surface layer of loam, silt loam, or fine sandy loam. Permeability is moderate and moderately rapid. Available water capacity is 7 to 12 inches. Runoff is medium. The hazard of water erosion is high, but the hazard of wind erosion is only slight. The frost-free season is 120 to 130 days.

Potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 1 year of grain and a new seeding of alfalfa and grass, 4 or 5 years of alfalfa-grass hay, 1 year of potatoes, 1 year of grain, and then 1 year of potatoes or beans. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this group are irrigated by the corrugation, contour furrow, or sprinkler method. Water erosion can be controlled by planting crops and irrigating on the contour where feasible and by giving careful attention to the rate at which water is applied and the length of the run. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by minimum tillage. Spots where the layer that contains a large amount of lime has been exposed by erosion, tillage, or land smoothing are less suited to crops, but in these spots manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops.

#### **CAPABILITY UNIT IIIc-52, IRRIGATED**

This unit consists of gently sloping, moderately deep, well-drained soils of the Minidoka and Portino series. These soils have a surface layer of silt loam and are underlain by a caliche hardpan or by bedrock. Permeability is moderate. Available water capacity is 4.5 to 7 inches. Runoff is medium, and the hazard of water erosion is high during irrigation. The frost-free season is about 125 days.

Potatoes, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 4 or 5 years of alfalfa-grass hay, 1 year of potatoes, 1 year of small grain, another year of potatoes, and then grain and a new seeding of alfalfa and grass. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated by the corrugation, contour furrow, or sprinkler method. They need moderately frequent irrigation because their available water capacity is only fair. Water erosion can be controlled by planting crops and irrigating on the contour where feasible and by giving careful attention to the rate at which irrigation water is applied and to the length of the run. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by use of minimum tillage. Spots where the layer that



**Figure 9.**—A bumper crop of mixed wheat and barley. The soil is Paulville loam, which is in capability unit IIc-50, irrigated.

contains a large amount of lime has been exposed by erosion, tillage, or land smoothing are less suited to crops, but in these spots manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops.

#### **CAPABILITY UNIT IIIe-69, IRRIGATED**

This unit consists of very gently sloping, moderately deep, well-drained soils of the Somsen, Taunton, and Vining series. These soils have a surface layer of sandy loam or fine sandy loam and are underlain by a caliche hardpan or by bedrock. Permeability is moderately rapid. Available water capacity is generally 3.5 to 5 inches but in places it is as low as 2.5 inches. Runoff is slow to medium during irrigation, and the hazard of water erosion is moderate. The hazard of wind erosion is slight. The frost-free season is about 120 to 130 days.

Somsen fine sandy loam, 4 to 8 percent slopes, has been included in this capability unit because the acreage is small. This soil is highly susceptible to water erosion and requires more careful irrigation to control erosion than the other soils in the unit.

Potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 4 or 5 years of alfalfa-grass hay, 1 year of beans, 2 years of small grain, 1 year of beans, and then 1 year of small grain and a new seeding of alfalfa and grass. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated by the corrugation or furrow method. Water erosion can be controlled by paying careful attention to the rate at which irrigation water is applied and to the length of the run. Wind erosion that occurs during seedbed preparation in spring can be controlled by keeping tillage to a minimum, using manure and crop residue, and including close-growing crops as much as possible.

#### **CAPABILITY UNIT IIIe-73, IRRIGATED**

This unit consists of nearly level to very gently sloping, very deep to moderately deep, dominantly well-drained soils of the Feltham, Maxey, Quincy, Schodson, Somsen, Tindahay, and Vining series. These soils have a surface layer of loamy sand or loamy fine sand and are underlain mostly by loamy sand, sand, fine sandy loam, or sandy loam. Permeability is moderately rapid to rapid. Available water capacity is 2 to 7 inches. Runoff is slow or very slow, and the hazard of water erosion is none to slight during irrigation, but the hazard of wind erosion is high. The frost-free season is 120 to 130 days.

Maxey loamy fine sand and Schodson loamy sand have been included in this capability unit because the acreage is relatively small. These soils are somewhat poorly drained and may require less frequent irrigation, but otherwise they need management similar to that for other soils in this unit. Quincy loamy sand is somewhat excessively drained.

Potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 3 or 4 years of small grain and 4 or 5 years of alfalfa-grass hay. Corn for silage and irrigated grass-legume pasture also work well in the cropping rotation.

Soils in this unit are irrigated by the border, corrugation, or furrow method. They need frequent irrigation of short duration because their available water capacity is only fair and their surface layer is sandy. Proper management of irrigation water is also needed to reduce leaching on these soils. Wind erosion can be controlled by planting field windbreaks, using minimum tillage, using manure and crop residue, and planting close-growing crops.

Adding manure and relatively large amounts of commercial fertilizer increases suitability for crops. Applications of nitrogen should be in smaller amounts and more frequent than those of phosphorus.

#### **CAPABILITY UNIT IIIe-75, IRRIGATED**

This unit consists of level and nearly level to very gently sloping, very deep and deep, well-drained soils of the Kecko and Paulville series. These soils have a surface layer of loamy fine sand and are underlain mostly by fine sandy loam or loam. Permeability is moderately rapid or moderately slow. Available water capacity is 7 to 10 inches. Runoff is slow, and the hazard of water erosion is none to slight, but the hazard of wind erosion is high. The frost-free season is 125 to 130 days.

Sugar beets, potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for soils in this unit is 4 years of alfalfa-grass hay; 1 year of potatoes, beans, or sugar beets; and then 2 years of small grain and a new seeding of alfalfa and grass. Corn for silage and irrigated grass-legume pasture also work well in the cropping system.

Soils in this unit are irrigated by the border, corrugation, or furrow method. They need fairly frequent irrigations of moderate duration because their surface layer is sandy. Wind erosion can be controlled by planting field windbreaks, using minimum tillage, using manure and crop residue, and planting close-growing

crops. Proper management of irrigation water, use of manure, and applications of relatively large amounts of commercial fertilizer increase the suitability of these soils for crops. Applications of nitrogen should be in smaller amounts and more frequent than those of phosphorus.

#### CAPABILITY UNIT IIIw-64, IRRIGATED

This unit consists of level and nearly level, moderately deep to deep, somewhat poorly drained soils of the Abo, Decker, Schodson, and Wodskow series. These soils have a surface layer of fine sandy loam, loam, sandy loam, or clay loam and are underlain by clay loam to sandy loam. Permeability is moderately slow to moderately rapid. Except for Schodson sandy loam, the soils in this unit are slightly saline to moderately saline and in places are slightly affected by alkali (fig. 10). Schodson sandy loam is not saline. Available water capacity is 4.5 to 10 inches. Runoff is slow, the hazard of water erosion is none to slight, and the hazard of wind erosion is slight. The frost-free season is 120 to 130 days.

Sugar beets, wheat, mixed grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 3 to 5 years of grass and a salt-tolerant legume for hay, 2 years of sugar beets, 1 year of small grain, and then 1 year of small grain and a new seeding of grass-legume. Irrigated grass-legume pasture also works well in the cropping system.

Soils of this unit are irrigated by the corrugation, furrow, or graded border method. The content of salts can be lessened by maintaining a low water table in summer and by leaching. The water table can be lowered

significantly by carefully avoiding excessive applications of water on porous soils. Salt can be leached from the surface layer by surface flooding before the seedbed is prepared. Schodson sandy loam does not require leaching or the growing of salt-tolerant crops. The small amount of wind erosion during seedbed preparation in spring can be controlled by minimum tillage.

Deep cuts should be avoided when leveling these soils, but where deep cuts have already been made, manure and commercial fertilizer can be applied, and these soon restore the soils to near normal suitability for crops. Areas less extensively cut can be improved by seeding them to a grass-legume mixture and applying relatively large amounts of commercial fertilizer.

#### CAPABILITY UNIT IIIs-53, IRRIGATED

This unit consists of Tindahay sandy loam, which is level and nearly level, very deep, and well drained. This soil is underlain predominantly by loamy sand. Permeability is moderately rapid. Available water capacity is about 5 inches. Runoff is slow, the hazard of water erosion is none to slight, and the hazard of wind erosion is slight. The frost-free season is about 130 days.

Beans (fig. 11), wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for this soil is 1 year of grain and a new seeding of alfalfa-grass hay followed by 3 or 4 years of alfalfa-grass hay and then 2 years of beans or small grain. Corn for silage and irrigated grass-legume pasture also work well in the cropping system.



Figure 10.—A sparse stand of sugar beets evident after freezedown. This is an area where the cuts made during land leveling exposed a strongly calcareous layer. The soil is Abo loam, saline, which is in capability unit IIIw-64, irrigated.

This soil is irrigated by the graded border, corrugation, or furrow method. It needs frequent irrigation of short duration because its available water capacity is only fair. Wind erosion that occurs during seedbed preparation in spring can be controlled by using minimum tillage, adding manure and crop residue, and including close-growing crops at regular intervals in the cropping system. Proper management of irrigation water, use of manure, and applications of relatively large amounts of commercial fertilizer increase the suitability of this soil for crops. Applications of nitrogen should be in smaller amounts and more frequent than those of phosphorus.

#### **CAPABILITY UNIT IIIs-66, IRRIGATED**

This unit consists of level and nearly level, deep, well-drained soils of the clayey subsoil variant of the Paulville series. These soils have a surface layer of silt loam or silty clay loam and are underlain by silty clay, heavy silty clay loam, or clay. Permeability is slow. Available water capacity is 10 to 12 inches. Runoff is ponded, and the hazard of water erosion is none to slight. The frost-free season is 120 to 130 days.

Sugar beets, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 3 years of alfalfa-grass hay followed by grain, sugar beets, and then grain again and a new seeding of alfalfa and grass. Corn for silage and irrigated grass-legume pasture also work well in the cropping system.

The soils in this unit are irrigated by the border, corrugation, or furrow method. Careful attention to the rate at which water is applied helps control over-irrigation and the ponding of water. Varying the depth of plowing and occasional ripping aid in maintaining adequate permeability in the subsoil. Paulville silty clay loam, clayey subsoil variant, can be worked only within a narrow range of moisture content. Application of water in excessive amounts causes waterlogging and soil baking, which affect plant growth. Adding manure and crop residue and seeding grass with alfalfa for hay are important in keeping the surface layer friable.

#### **CAPABILITY UNIT IVe-50, IRRIGATED**

This unit consists of sloping, mainly very deep, well-drained soils of the Portneuf and Wheeler series. These soils are silt loam throughout. They are commonly part of fields where soils are less sloping. Permeability is moderate. Available water capacity is 8 to 12 inches. Runoff is rapid, and the hazard of water erosion is very high. The frost-free season is 120 to 130 days.

Potatoes, beans, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 5 or 6 years of alfalfa-grass hay, 2 or 3 years of grain, and then 1 year of grain and a new seeding of alfalfa and grass. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated by the corrugation, furrow, or sprinkler method. Water erosion can be controlled by planting and irrigating on the contour or across the slope; by giving careful attention to the rate at which irrigation water is applied and to the length of the run;



*Figure 11.—An especially good crop of beans. The soil is Tindahay sandy loam, which is in capability unit IIIs-53, irrigated.*

or by using the sprinkler method of irrigation. The small amount of wind erosion that occurs during seedbed preparation in spring can be controlled by use of minimum tillage. Spots where the layer that contains a large amount of lime has been exposed by erosion and tillage are less suited to crops. Applying manure and relatively large amounts of commercial fertilizer helps restore these spots to near normal suitability for crops.

#### **CAPABILITY UNIT IVe-52, IRRIGATED**

This unit consists of sloping, moderately deep, well-drained soils of the Minidoka and Portino series. The soils have a surface layer of silt loam and are underlain by a caliche hardpan or by bedrock. They are commonly part of fields where soils are less sloping. Permeability is moderate. Available water capacity is generally 5 to 7.5 inches, but in places it is as low as 4.5 inches. Runoff is rapid, and the hazard of erosion is very high. The frost-free season is about 125 days.

Potatoes, wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 5 years of alfalfa-grass hay, 2 years of grain, and then 1 year of grain and a new seeding of alfalfa and grass. Irrigated grass-legume pasture also works well in the cropping system.

Soils in this unit are irrigated by the sprinkler method. Water erosion can be controlled by using properly designed sprinkler systems that apply water no more rapidly than the soil can absorb it and by moving the set before the soil becomes saturated. The small amount of wind erosion that occurs during seedbed preparation in spring

can be controlled by minimum tillage. Spots where the layer that contains large amounts of lime has been exposed by erosion and tillage are less suited to crops. Applying manure and relatively large amounts of commercial fertilizer helps improve these spots to near normal suitability for crops.

#### **CAPABILITY UNIT IVe-74, IRRIGATED**

This unit consists of gently sloping, moderately deep to very deep, well-drained or excessively drained soils of the Feltham, Quincy, Somsen, and Vining series. These soils have a surface layer of loamy sand and are underlain mainly by sandy loam or loamy sand. Permeability is moderate to rapid. Available water capacity is 2.5 to 6 inches. Runoff is slow to medium, and during irrigation the hazard of water erosion is moderate to high. The hazard of wind erosion is high.

Wheat, mixed small grains, alfalfa hay, and pasture are the major crops and are generally grown in rotation. A typical cropping system for the soils in this unit is 1 year of small grain and a new seeding of alfalfa and grass, 4 to 6 years of alfalfa-grass hay, 1 or 2 years of small grain, and then 1 year of beans. Corn for silage and irrigated grass-legume pasture also work well in the cropping system.

Soils of this unit are irrigated by the corrugation or contour furrow method. They need frequent irrigation of short duration because their available water capacity is only fair and the surface layer is coarse textured. Water erosion can be controlled by planting crops and irrigating on the contour where feasible and by giving careful attention to the rate at which irrigation water is applied and to the length of the run. Proper management of irrigation water is also important in reducing the leaching of valuable plant nutrients and wasting of water. Wind erosion can be controlled by planting field windbreaks and by using rough tillage and keeping it to a minimum. Applying manure and crop residue and planting close-growing crops help reduce the hazards of wind and water erosion.

Adding manure and relatively large amounts of commercial fertilizer increases suitability for crops. Applications should be in smaller amounts and more frequent for nitrogen than for phosphorus.

#### **CAPABILITY UNIT VIe-55, IRRIGATED PASTURE**

This unit consists of very gently sloping to strongly sloping, shallow to very deep, well-drained soils of the Portneuf, Somsen, Trevino, and Vining series and Rock outcrop. Slopes are complex, and there are few to many rock outcrops and extremely stony spots. The soils have a surface layer of loamy sand, sandy loam, or silt loam. Permeability is moderately rapid to moderate. Available water capacity is 2 to 12 inches. Because the slopes are irregular, runoff is variable. The hazard of erosion is none to very high, depending on the slope. The frost-free season is 120 to 130 days.

Irrigated grass or grass-legume pasture has a significant increase in nutritional value and growth where nitrogen and phosphorus are applied.

Soils of this unit are irrigated by the sprinkler or corrugation method. The sprinkler method of irrigation is desirable because it is the most efficient method of

applying water in areas of rock outcrops, extremely stony spots, and irregular slopes. Irrigated pasture is the most appropriate use for soils of this unit. In some places where sprinkler irrigation is used, particularly on the Portneuf-Trevino complex, it may be practical to use areas of these soils in cultivated fields with other soils.

#### **CAPABILITY UNIT VIe-846, NONIRRIGATED**

This unit consists of gently sloping to sloping, moderately deep to very deep, well-drained soils of the Declo, Escalante, Minidoka, Portino, Portneuf, Somsen, and Wheeler series. These soils have a surface layer of loam, fine sandy loam, and silt loam. Permeability is moderate to moderately rapid. Available water capacity is 3 to 12 inches. Runoff is medium to rapid, and the hazard of water erosion is slight to moderate. Average annual precipitation ranges from 8 to 11 inches, and the frost-free season is 120 to 130 days.

Soils of this unit are used for range or are idle. The vegetation in most areas is big sagebrush, cheatgrass, and weeds. A few areas have big sagebrush, Sandberg bluegrass, sod wheatgrass, and scattered Indian ricegrass.

Seeding Nordan or Siberian wheatgrass improves production and increases the ground cover on most soils in this unit. Where good stands of native grass are growing and the plant cover is in fair or good condition, careful attention to intensity of grazing helps maintain the stand of native grass.

#### **CAPABILITY UNIT VIw-54, IRRIGATED PASTURE**

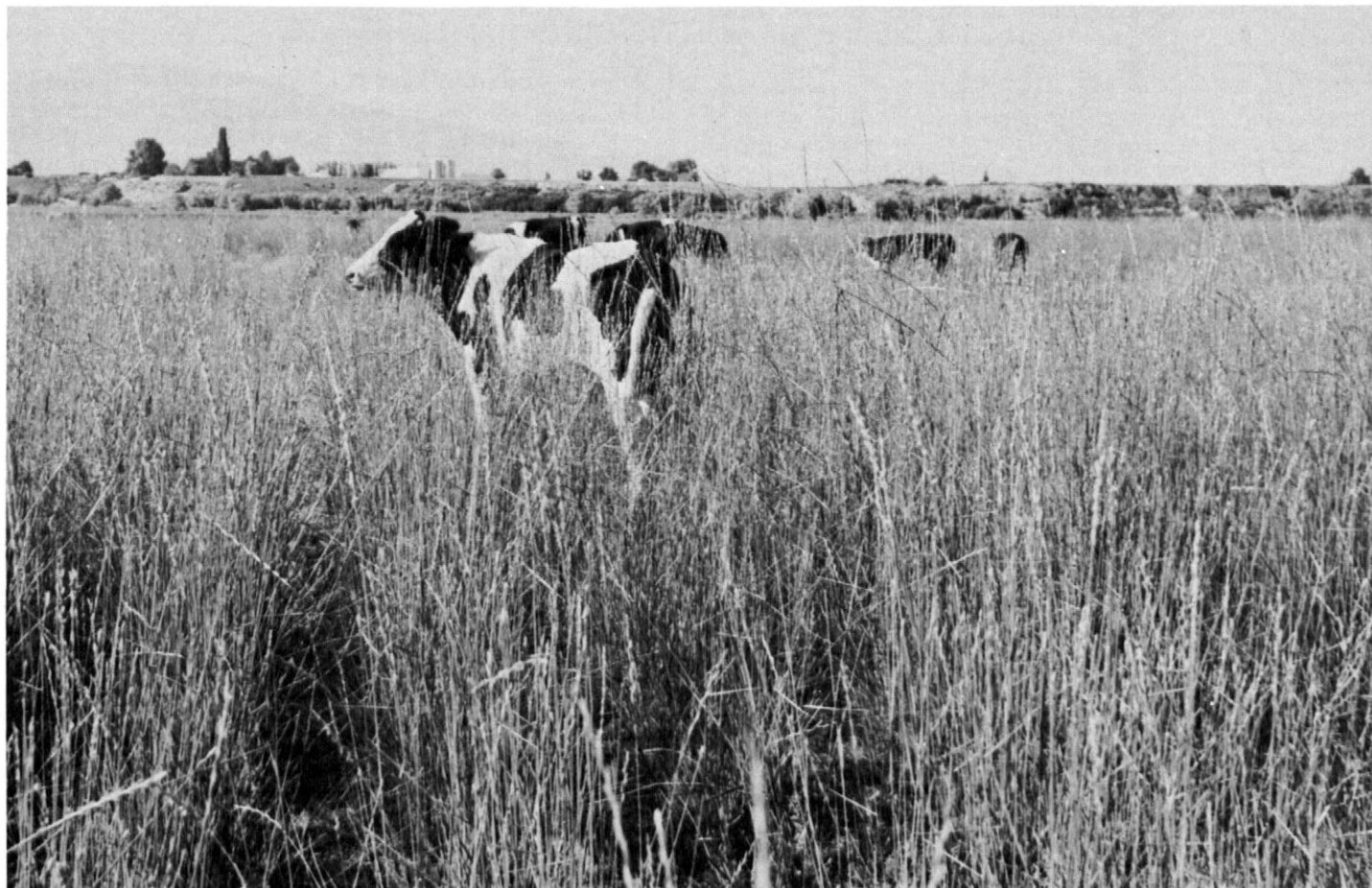
This unit consists only of Abo clay loam, alkali variant. This soil is level and nearly level, very deep, somewhat poorly drained, and moderately saline-alkali. Permeability is slow in the upper part of the soil and moderately rapid in the lower part. Available water capacity is 7 or 8 inches. Runoff is slow or ponded, and during irrigation the hazard of water erosion is none to slight. The frost-free season is about 130 days.

Reclamation of this soil is not considered feasible. Irrigated pasture is the best possible use, and the corrugation or border method of irrigation is used. Seeding salt- and alkali-tolerant grasses and legumes and giving careful attention to seeding and irrigation are important in establishment of suitable pasture (fig. 12). The growth and nutritive value of irrigated grasses or grasses and legumes are increased significantly if nitrogen and phosphorus are applied.

#### **CAPABILITY UNIT VIe-838, NONIRRIGATED**

This unit consists of level and nearly level, very deep, well-drained soils of the Paulville series, clayey subsoil variant. These soils have a surface layer of silt loam or silty clay loam and a subsoil of silty clay or clay. Permeability is slow. Available water capacity is 10 to 12 inches. Runoff is ponded, and the hazard of water erosion is none to slight. Average annual precipitation ranges from 8 to 11 inches, but these soils receive runoff from higher lying soils.

Soils in this unit are used for range or are idle. In most places the vegetation is silver sagebrush, three-tip sagebrush, squirreltail, big sagebrush, cheatgrass, and weeds, but there is some Sandberg bluegrass, Indian ricegrass, and bluebunch wheatgrass.



**Figure 12.**—Successfully established stand of tall wheatgrass in irrigated pasture where the soil is saline-alkali. The soil is Abo clay loam, alkali variant, which is in capability unit VIw-54, irrigated pasture.

Seeding Nordan wheatgrass or Siberian wheatgrass improves the suitability for pasture crops and increases the ground cover on most soils in this unit. Careful attention to intensity of grazing helps to maintain the stand of native grass where there are good stands of native grass and the plant cover is in fair or good condition.

#### **CAPABILITY UNIT VIa-841, NONIRRIGATED**

This unit consists of very gently sloping to strongly sloping, shallow to very deep, well-drained soils of the Portneuf, Somsen, Trevino, and Vining series and Rock outcrop. There are common or many rock outcrops and extremely stony spots. The soils have a surface layer of loamy sand to silt loam. Scattered basalt fragments are common in many of the soils. Permeability is moderate to rapid. Available water capacity is mainly 2 to 5 inches but in places is as much as 12 inches. Runoff is slow to rapid, and the hazards of water and wind erosion are slight to moderate. Average annual precipitation ranges from 8 to 11 inches.

Soils of this unit are used for range or are idle. In most places the vegetation is big sagebrush and annual weeds and grasses. Bluebunch wheatgrass, Sandberg blue-

grass, needle-and-thread, and Indian ricegrass are some of the more important grasses where the vegetation has not been overgrazed.

The feasibility of seeding most of these soils is only fair. Where the present vegetation is in good condition, it should be protected to maintain the ground cover and sustain its use. This can be done by carefully controlling the intensity of grazing.

#### **CAPABILITY UNIT VIc-835, NONIRRIGATED**

This unit consists of level to very gently sloping, deep and very deep, well-drained soils of the Declo, Escalante, Kecko, Kimama, Minidoka, Portino, Portneuf, Somsen, Taunton, and Vining series. These soils have a surface layer of fine sandy loam, loam, or silt loam and a subsoil of loam, silt loam, sandy loam, or fine sandy loam. Permeability is moderate to moderately rapid. Available water capacity is 2.5 to 12 inches. Runoff is slow, and the hazard of water erosion is none to slight. Average annual precipitation ranges from 8 to 11 inches, and the Kimama soil receives significant amounts of runoff from higher areas. The frost-free season is 120 to 130 days.

Soils of this unit are used for range or are idle. In most areas the vegetation is big sagebrush, cheatgrass, and

weeds, but in a few areas there is big sagebrush or three-tip sagebrush, Sandberg bluegrass, needle-and-thread, and bluebunch wheatgrass.

Seeding Nordan or Siberian wheatgrass improves production and increases the ground cover in most areas of these soils. Where good stands of native grass are growing and the plant cover is in fair or good condition, careful attention to intensity of grazing helps maintain the stand of native grass.

#### **CAPABILITY UNIT VIIe-969, NONIRRIGATED**

This unit consists of level to strongly sloping, moderately deep to very deep, well-drained to excessively drained soils of the Feltham, Kecko, Paulville, Quincy, Somsen, Tindahay, and Vining series. These soils have a surface layer of loamy fine sand, loamy sand, or sand and are underlain by sandy loam to sand. Permeability is moderately rapid to rapid. Available water capacity is 2.5 to 10 inches. Runoff is medium to very slow. The hazard of wind erosion is high to very high. Average annual precipitation ranges from 8 to 10 inches. The frost-free season is 120 to 130 days.

Soils of this unit are used for range or are idle. The vegetation is mainly big sagebrush, cheatgrass, and weeds, but in a few areas it is big sagebrush, needle-and-thread, Indian ricegrass, and Sandberg bluegrass.

The successful seeding of grass on these soils is questionable. Consequently, it is a good practice to protect the present vegetation. This can be done by carefully regulating the time and intensity of grazing.

#### **CAPABILITY UNIT VIIe-975, NONIRRIGATED**

This unit consists only of Wheeler silt loam, 12 to 30 percent slopes. This soil is very deep and well drained. It is silt loam throughout and has a very friable subsoil. Permeability is moderate. Available water capacity is 8 to 12 inches. Runoff is rapid, and the hazard of water erosion is high. Average annual precipitation ranges from 8 to 10 inches.

This soil is used for range or is idle. In most areas the vegetation is big sagebrush and annual weeds and grasses, but in a few areas it is big sagebrush, winterfat, needle-and-thread, and cheatgrass.

Successful seeding on this soil is questionable. Consequently, it is a good practice to protect the present vegetation. This can be done by the careful control of grazing.

#### **CAPABILITY UNIT VIIw-969, NONIRRIGATED**

This unit consists only of Abo clay loam, alkali variant. This soil is nearly level, very deep, somewhat poorly drained, and moderately affected by soluble salts and alkali. It has a subsoil of clay loam and loam and is underlain by stratified sandy loam, loamy fine sand, and fine sandy loam. Permeability is slow in the upper part of the profile and moderately rapid in the lower part. Available water capacity is 7 or 8 inches. Runoff is slow, and the hazard of water erosion is none to slight. Average precipitation is about 9 inches.

This soil is used for range or is idle. In most places the vegetation is greasewood, big sagebrush, alkaligrass, and peppergrass, but in some areas it is only greasewood

and in others only alkaligrass. Careful grazing helps maintain the desirable vegetation.

#### **CAPABILITY UNIT VIIe-970, NONIRRIGATED**

This unit consists of very gently sloping to strongly sloping, shallow to very deep, well-drained soils of the Quincy, Somsen, Trevino, and Vining series and Rock outcrop. These soils have a surface layer of sand to silt loam. There are many rock outcrops and extremely stony spots, and scattered basalt fragments are common on the surface in many areas. Permeability is moderate to rapid. Available water capacity is 2.5 to 5 inches. Runoff is very slow to rapid, and the hazards of water and wind erosion are none or slight to very high. Average annual precipitation ranges from 8 to 11 inches.

Soils of this unit are used for range or are idle. In most places the vegetation is big sagebrush, annual weeds, and grasses.

The feasibility of seeding most of these soils is very poor; consequently, the present vegetation should be protected to maintain the ground cover. This can be done by the careful control of grazing.

#### **CAPABILITY UNIT VIIIe-985, NONIRRIGATED**

This unit consists only of Rock land. This miscellaneous land type has a wide range in slope. It is principally bedrock, but pockets of soil material are in the cracks or crevices and depressions. The soil material is mainly loam or silt loam, but in places it is sandy loam or loamy sand.

This land type has little use, although it provides a small amount of wildlife grazing and cover. The vegetation is low-growing big sagebrush and grass.

## **Estimated Yields**

Table 2 shows estimates of yields for the principal field crops grown in the survey area under two levels of management. All the crops listed are grown under irrigation. Only the soils on which at least one of the crops is grown are listed. The estimates are based on the observations of soil scientists and on information furnished by farmers in the survey area, by companies that process farm products, by the local office of the Agricultural Conservation and Stabilization Service, and by Agricultural Census reports. If no information could be obtained for a particular soil, estimates were made on the basis of information pertaining to a similar soil.

The soils and climate in the Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties, provide a potential for good yields of a wide variety of crops, and the cost of land and of farming operations requires that good management be used to obtain high yields. Yields shown in columns A are based on the management most commonly used in the survey area. Under this level of management, a regular cropping system is followed. For example, the cropping system may include alfalfa hay, generally grown for 2 to 4 years; a row crop, such as potatoes, sugar beets, beans, or corn, for 2 years; grain; a row crop; and then small grain and a new seeding of a legume. Fertilizers are used in the kinds and amounts based on general experience, the requirements of the soils, and the needs of the crop, but the rate of application and kind of fertilizer used generally are not consistent or uniform for

all fields or for the same crops on similar soils. Irrigation water is not always carefully attended and controlled. Generally, additional land leveling or smoothing is needed, and in many places the drainage systems are not adequate.

The yields shown in columns B are based on improved or more intensive management. A systematic cropping system that includes legumes, grass, manure, green-manure crops, and crop residue is used so that the content of organic matter, fertility, and favorable soil structure are maintained. Fertilizers and soil amendments are applied according to the results indicated by soil tests and field or plot trials. The land has been prepared and irrigation systems developed so that the water required by the crops can be spread uniformly over each field. Drainage systems have been installed to remove excess irrigation water or ground water, and toxic salts or alkali have been reduced or eliminated. Harmful insects and weeds are controlled. Many of these practices are also used by farmers producing the yields listed in columns A, but the intensity and timeliness are less exact.

About the same varieties of crops are grown under both levels of management. They are mainly adapted varieties of hybrid corn, the Idaho russet potato, and Ranger or common alfalfa. The wheat yields listed are for the Gaines variety. The increase in yields of hay and pasture shown under improved management, compared with common management, results mainly from the seeding of improved varieties of grasses and legumes, the proper application of fertilizer, and better management of water. Improved varieties of grasses for hay and pasture are Latar orchardgrass, alta fescue, and tall wheatgrass.

Several important limitations should be kept in mind when using the yield estimates in table 2. First, the figures are estimates or predictions. Second, they are averages that can be expected over a period of years; in any given year the yield may be considerably higher or lower than the average. Third, there is considerable variation within some soils, for example, variations due to salts and alkali; this fact was considered in making the estimates.

The information on yields and management practices provided in this part of the survey will be most useful and helpful only for a short time immediately after publication of the report. New developments in crop breeding, control of insects and diseases, fertilizers, tillage, irrigation, and drainage change the yields.

## Use of the Soils for Windbreaks <sup>2</sup>

This section contains information about establishing and managing field and farmstead windbreaks on soils on which they are considered most useful.

Originally, cottonwood and willow occupied much of the streambanks and flood plains along the Snake River. The uplands, or Snake River Plains, supported mainly sagebrush and grass. A small proportion of the survey area supported saltgrass and greasewood on saline and alkali soils.

Management of trees and shrubs for windbreaks can be more easily planned if soils are grouped according to

those characteristics and qualities that affect the growth and management of trees. For this reason, the soils of the Minidoka Area have been placed in six windbreak groups. Each group consists of soils that have about the same suitability for trees and require about the same management. In each group the suitability of the soils for growing windbreaks, the better suited trees and shrubs, and the major hazards and limitations of the soils are described.

### *Planting and management*

Trees do best in firm, moist soil that is free of weeds and grasses. The planting site may be summer-fallowed, if necessary, to eliminate weeds.

The seedlings need prompt attention when they arrive from the nursery. They should be kept moist and cool.

A young windbreak should be cultivated often to control weeds. In irrigated areas, cultivation should be continued for at least 3 years. For optimum growth, trees should be cultivated from the time they are planted until their tops close and shade out competitive weeds and grass. They should be protected from damage caused by livestock, poultry, and fire. They should also be properly protected from mice, gophers, rabbits, porcupines, insects, diseases, and sometimes herbicides, which are serious threats.

*Irrigation.*—The young seedlings should be irrigated immediately after planting. Thereafter, frequent irrigations are necessary to keep the root zone moist during the establishment year. A young windbreak should be irrigated every 7 to 10 days during the peak irrigation season of July and August. After the establishment year, the frequency of irrigation needed during the peak season depends on soil texture, depth, and annual root development of the trees.

### *Farmstead windbreaks*

To provide maximum protection of the farmstead, livestock, orchards, and gardens, careful consideration of the following is important for maximum benefits:

*Location of windbreaks.*—Windbreaks are most effective if placed at right angles to the prevailing wind. Plantings should be about 100 feet from the building and extend 50 feet beyond the building boundaries to keep wind from whipping around the end of the windbreak into the area that needs protection.

*Number of rows.*—A 5-row planting makes an efficient farmstead windbreak. If limited space prevents use of 5 rows, fewer rows should be used rather than crowding the trees.

*Arrangement of rows.*—A combination of trees and shrubs should be used that forms a dense year-round wind barrier from the ground level to the height of the windbreak. This is achieved by planting, from the windward side, a first row of shrubs, a second row of medium trees, a third row of tall trees, a fourth row of tall evergreens, and a fifth row of dense-growing evergreens.

*Kinds of trees.*—Trees and species should be used that grow and do well on the specific soils. Commonly used species are listed in the description of each windbreak group.

*Spacing.*—Trees should be given room to grow by allowing adequate growing space, which tends to keep

<sup>2</sup> By M. R. CARLSON, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Estimated average yields per acre of principal*

[Yields in columns A can be expected under common management; those in columns B can be expected under improved

Soil	Beans <sup>1</sup>		Corn for silage		Peas	
	A	B	A	B	A	B
	Cwt.	Cwt.	Tons	Tons	Cwt.	Cwt.
Abo clay loam, alkali variant.....						
Abo clay loam, saline.....						
Abo loam.....	16	22	18	25		
Abo loam, saline.....						
Abo sandy loam.....	16	22	17	21		
Arloval loamy fine sand.....	16	22	16	20		
Arloval sandy loam.....	16	22	16	20		
Clems sandy loam.....	16	22	17	21		
Decker fine sandy loam.....	16	22	17	21		
Decker fine sandy loam, saline.....						
Decker loam.....	16	22	17	21		
Decker loam, saline.....						
Declo fine sandy loam, 0 to 2 percent slopes.....	16	22	17	21		
Declo loam, 0 to 2 percent slopes.....	16	22	17	21		
Declo loam, 2 to 4 percent slopes.....	16	22	17	21		
Declo loam, 4 to 8 percent slopes.....	14	20	15	19		
Escalante fine sandy loam, 0 to 2 percent slopes.....	16	22	17	21		
Escalante fine sandy loam, 2 to 4 percent slopes.....	16	22	17	21		
Escalante fine sandy loam, 4 to 8 percent slopes.....	14	20	15	19		
Feltham loamy sand, 0 to 4 percent slopes.....	15	18				
Feltham loamy sand, 4 to 8 percent slopes.....	13	16				
Kecko fine sandy loam, 0 to 2 percent slopes.....	16	22	17	21		
Kecko fine sandy loam, 2 to 4 percent slopes.....	16	22	17	21		
Kecko loamy fine sand, 0 to 4 percent slopes.....	16	22	17	21		
Kimama silt loam.....	16	22	18	25	26	35
Maxey loamy fine sand (0 to 2 percent slopes).....	16	21	16	20		
Minidoka silt loam, 0 to 2 percent slopes.....					26	35
Minidoka silt loam, 2 to 4 percent slopes.....					26	35
Minidoka silt loam, 4 to 8 percent slopes.....					22	30
Minidoka silt loam, 8 to 12 percent slopes.....						
Paulville loamy fine sand.....	16	22	16	20		
Paulville fine sandy loam.....	16	22	18	25		
Paulville loam.....	16	22	18	25		
Paulville clay loam.....	16	22	18	25		
Paulville silt loam, clayey subsoil variant.....			18	25		
Paulville silty clay loam, clayey subsoil variant.....						
Portino silt loam, 0 to 2 percent slopes.....					26	35
Portino silt loam, 2 to 4 percent slopes.....					26	35
Portino silt loam, 4 to 8 percent slopes.....					22	30
Portino silt loam, 8 to 12 percent slopes.....						
Portneuf silt loam, 0 to 2 percent slopes.....	18	25	18	25	26	35
Portneuf silt loam, 2 to 4 percent slopes.....	18	25	18	25	26	35
Portneuf silt loam, 4 to 8 percent slopes.....	16	22			22	30
Portneuf silt loam, 8 to 12 percent slopes.....	15	21			18	25
Portneuf-Trevino complex, 2 to 20 percent slopes.....						
Quincy loamy sand, 2 to 4 percent slopes.....	13	16				
Quincy loamy sand, 4 to 8 percent slopes.....	11	14				
Schodson loamy sand.....	14	20	16	20		
Schodson sandy loam.....	14	20	17	21		
Schodson sandy loam, saline.....						
Somsen loamy sand, 0 to 4 percent slopes.....	14	20	14	17		
Somsen loamy sand, 4 to 8 percent slopes.....	13	16	12	15		
Somsen fine sandy loam, 2 to 4 percent slopes.....	16	22	15	19		
Somsen fine sandy loam, 4 to 8 percent slopes.....	14	20	13	16		
Somsen-Rock outcrop complex, 2 to 20 percent slopes.....						
Taunton sandy loam, 2 to 4 percent slopes.....	16	20	15	19		
Tindahay loamy sand.....	15	21				
Tindahay sandy loam.....	15	21				
Trevino-Rock outcrop complex, 2 to 20 percent slopes.....						
Vining loamy sand, 0 to 4 percent slopes.....	15	21	14	17		
Vining loamy sand, 4 to 8 percent slopes.....	13	16	12	15		
Vining fine sandy loam, 2 to 4 percent slopes.....	16	22	15	19		
Vining-Rock outcrop complex, 2 to 20 percent slopes.....						
Wheeler silt loam, 8 to 12 percent slopes.....						
Wodskow sandy loam.....	16	22	16	20		
Wodskow sandy loam, saline.....						

<sup>1</sup> Yields for commercial varieties.<sup>2</sup> Yields for the Gaines variety.

*irrigated crops under two levels of management*

management; absence of yield indicates the crop is not generally grown or that the soil is not suited to the crop]

Potatoes		Sugar beets		Barley		Mixed grains		Wheat <sup>2</sup>		Alfalfa hay		Pasture	
A	B	A	B	A	B	A	B	A	B	A	B	A	B
<i>Cwt.</i>	<i>Cwt.</i>	<i>Tons</i>	<i>Tons</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Tons</i>	<i>Tons</i>	<i>AUM</i> <sup>3</sup>	<i>AUM</i> <sup>3</sup>
		14	18	55	80	50	65	50	65	3	4	8	12
		16	20	60	95	65	80	70	100	4	5	8	12
		16	20	60	95	55	70	60	80	3	4	13	18
		16	20	60	95	60	80	70	100	4	5	8	12
		16	20	40	50	40	55	60	80	4	5	13	18
		16	20	40	50	40	55	60	80	4	5	13	18
175	250	16	20	40	50	60	80	65	90	4	5	13	18
		16	20	60	95	60	80	70	100	4	5	13	18
		14	18	60	95	55	70	60	80	3	4	8	12
		16	20	60	95	60	80	70	100	4	5	13	18
		14	18	60	95	55	70	60	80	3	4	8	12
200	275	16	20	60	95	60	80	65	90	4	5	13	18
200	275	16	20	80	100	60	80	70	100	4	5	13	18
200	275	16	20	80	100	60	80	70	100	4	5	13	18
150	225	14	18	70	90	50	70	65	90	3	4	13	16
175	250	16	20	60	95	60	80	65	90	4	5	13	18
175	250	16	20	60	95	60	80	65	90	4	5	13	18
150	225	14	17	60	90	50	70	55	75	3	4	13	16
				50	70	45	50	50	75	3	4	11	14
				45	60	35	45	45	70	3	4	11	14
175	250	16	20	60	95	60	80	65	90	4	5	13	18
175	250	16	20	60	95	60	80	65	90	4	5	13	18
150	225	14	18	55	80	55	70	60	80	4	5	13	16
225	310	18	22	80	100	80	100	80	110	4	6	13	18
		15	19	50	70	55	65	60	80	4	5	13	16
200	275	15	18	80	95	60	80	70	95	4	5	13	18
200	275	15	18	80	95	60	80	70	95	4	5	13	18
175	225	14	16	70	85	55	70	65	90	3	4	13	16
				40	60	40	60	45	65	3	4	11	14
150	225	15	19			55	70	60	80	3	4	13	16
210	300	16	20			65	80	70	90	4	5	13	18
210	300	16	20			70	90	70	100	4	5	13	18
		16	20			70	90	70	100	4	5	13	18
		16	20	70	90	70	90	70	100	4	5	13	18
		16	20	70	90	70	90	70	100	4	5	13	18
200	275	15	18	80	95	60	80	70	95	4	5	13	18
200	275	15	18	80	95	60	80	70	95	4	5	13	18
175	225	14	16	70	85	55	70	65	90	3	4	13	16
				40	60	40	60	45	65	3	4	11	14
200	275	16	20	80	100	80	100	80	110	4	6	13	18
200	275	16	20	80	100	80	100	80	110	4	6	13	18
175	225	15	18	70	90	70	90	65	90	3	4	13	16
				40	60	40	60	45	65	3	4	11	14
												8	12
						40	60	40	65	3	4	8	12
						40	60	40	65	2	3	8	12
		16	20	50	70	40	60	50	75	4	5	13	18
		16	20	50	70	55	65	60	75	4	5	13	16
		16	20	50	70	55	65	40	50	3	4	13	18
				40	60	40	60	60	75	4	5	13	16
				40	50	35	50	50	65	3	4	11	14
				50	70	55	65	60	75	4	5	13	18
				45	60	40	60	50	65	3	4	13	16
												6	10
				50	70	55	65	60	75	4	5	13	18
						40	60	60	75	4	5	11	14
						40	60	60	75	4	5	13	16
												6	10
				40	60	40	60	60	75	4	5	13	16
				40	50	35	50	50	65	3	4	11	14
				50	70	55	65	60	75	4	5	13	18
												6	10
				40	60	40	60	45	60	3	4	11	14
		16	20	55	80	60	80	65	90	4	5	13	18
		16	20	55	80	50	65	40	50	3	4	11	14

<sup>3</sup> AUM (animal-unit-months) is the number of months 1 acre provides grazing for 1 animal unit (1 cow, steer, or horse; or 5 hogs; or 7 sheep or goats) without injury to the pasture.

them growing vigorously. The spacings that have been proved sound through experiments are shown, as follows: Shrubs should be planted 3 feet apart in the row, and tall trees and evergreens 8 to 12 feet apart within the rows. Although generally determined by the size of the cultivation equipment, the distance between the rows should be 14 to 16 feet on irrigated soils.

### **Field windbreaks**

Field plantings have not been extensively used in the Minidoka Area, although they are potentially valuable for control of wind erosion and for crop protection. Their benefits are most apparent on sandy soils, where they are especially effective if combined with other conservation measures in controlling wind erosion, reducing evaporation of soil moisture, and protecting crops from drying out and from mechanical damage caused by winds.

Evergreen trees, such as pine and spruce, make the most effective and enduring windbreak. However, their relatively slow growth rate and the difficulty of establishing them have resulted in the use of deciduous trees, such as poplar, Russian-olive, and black locust.

Field windbreaks should be carefully planned to fit the needs of the soil. They should be located in relation to field boundaries and irrigation systems. An effective, major, 3-row windbreak placed along the windward border may consist of a row of shrubs on the windward side, a row of tall trees, and then a row of evergreens. Single-row, supplemental windbreaks can be placed across the field. Spacing of trees in field windbreaks is the same as that listed under "Farmstead windbreaks."

### **Management by windbreak groups**

In the following pages the windbreak groups in the Minidoka Area are described and suggestions for the use and management of the soils in these groups are given. The names of the soil series represented are mentioned in the description of each group, but this does not mean that all the soils in a given series are in the group. The windbreak group in which a given mapping unit has been placed can be learned from the "Guide to Mapping Units."

Mapping units not placed in a windbreak group are Portneuf-Trevino complex, 2 to 20 percent slopes; Quincy sand, 2 to 12 percent slopes; Quincy-Rock outcrop complex, 2 to 12 percent slopes; Rock land; Rock outcrop-Trevino complex, 2 to 20 percent slopes; Somsen-Rock outcrop complex, 2 to 20 percent slopes; Somsen-Vining complex, 2 to 20 percent slopes; Trevino-Portneuf complex, 2 to 20 percent slopes; Trevino-Rock outcrop complex, 2 to 20 percent slopes; Vining-Quincy complex, 2 to 20 percent slopes; Vining-Rock outcrop complex, 2 to 20 percent slopes; Vining and Somsen soils and Rock outcrop, 2 to 20 percent slopes; Wheeler silt loam, 8 to 12 percent slopes; and Wheeler silt loam, 12 to 30 percent slopes.

#### **WINDBREAK GROUP 71**

This group consists of well-drained soils of the Clems, Declo, Escalante, Kecko, Kimama, Minidoka, Paulville, Portino, Portneuf, Somsen, Taunton, and Vining series. These soils are on low terraces and basalt plains. They have a surface layer of fine sandy loam, loamy fine sand, sandy loam, silt loam, loam, clay loam, and silty clay

loam. They are more than 20 inches deep over sand, gravel, a hardpan, or bedrock. Most of these soils are mildly alkaline or moderately alkaline, but the Kimama and Vining soils are slightly acid or neutral. Slopes range from 0 to 4 percent.

The growth of trees is excellent after they have been established. Limitations of the site that are caused by soil features are few and minor.

The adapted deciduous trees are Russian-olive, golden willow, black locust, green ash, and hybrid poplar. Adapted shrubs are caragana (Siberian pea), Nanking cherry, lilac, southernwood, mulberry, cotoneaster, clearwater rose, Tatarian honeysuckle, common privet, western mountain-ash, and mugo pine. The adapted evergreens are Rocky Mountain juniper, Douglas-fir, Austrian pine, Scotch pine, Norway spruce, ponderosa pine, and blue spruce.

The junipers are hosts to the cedar-apple rust disease and, consequently, should not be planted in communities where there are apple orchards.

#### **WINDBREAK GROUP 72**

This group consists of well-drained, mildly alkaline or moderately alkaline soils of the Declo, Escalante, Minidoka, Portino, Portneuf, and Somsen series. These soils are on low ridges on terraces and basalt plains on the sides of drainageways. They have a surface layer of fine sandy loam, silt loam, and loam and are more than 20 inches deep to sand, gravel, a hardpan, or bedrock. Slopes range from 4 to 12 percent.

The adapted deciduous trees are Russian-olive, golden willow, black locust, green ash, and hybrid poplar. Adapted shrubs are caragana (Siberian pea), Nanking cherry, lilac, southernwood, mulberry, cotoneaster, clearwater rose, Tatarian honeysuckle, common privet, western mountain ash, and mugo pine. The adapted evergreens are Rocky Mountain juniper, Douglas-fir, Austrian pine, Scotch pine, Norway spruce, ponderosa pine, and blue spruce.

In irrigated areas, the hazard of water erosion is moderate to high. Control of weeds by chemicals is needed where slopes are erodible. The junipers are hosts to the cedar-apple rust disease and, consequently, should not be planted in communities where there are apple orchards.

#### **WINDBREAK GROUP 73**

This group consists only of Abo clay loam, alkali variant. This soil is on low terraces. It is strongly alkaline or very strongly alkaline, saline-alkali, somewhat poorly drained, and deep to sand or gravelly sand. It has a surface layer of clay loam. Slopes range from 0 to 2 percent.

The adapted deciduous trees are hybrid poplar, willow, and Russian-olive. Adapted shrubs are clearwater rose and cotoneaster. The adapted evergreen is Rocky Mountain juniper.

A high water table and salinity and alkalinity limit the choice of trees and shrubs that can grow on this soil. Drainage is generally needed if desirable trees and shrubs are to do well.

#### **WINDBREAK GROUP 74**

This group consists of somewhat poorly drained, saline, mostly mildly alkaline to strongly alkaline soils of the

Abo, Decker, Schodson, and Wodskow series. These soils are on low terrace benchlands. They have a surface layer of sandy loam, loam, fine sandy loam, and clay loam and are more than 20 inches deep to sand or gravelly sand. They have a fluctuating high water table in summer. Slopes are 0 to 4 percent.

The adapted deciduous trees are green ash and black locust. The adapted shrub is cotoneaster. Adapted evergreens are Rocky Mountain juniper and Norway spruce.

The fluctuating high water table and the salinity limit the choice of trees and shrubs that can be grown on these soils. They also increase the amount of management required for windbreak plantings. Excess water needs to be drained from these soils.

#### WINDBREAK GROUP 75

This group consists of well-drained or somewhat excessively drained, neutral to moderately alkaline soils of the Feltham, Quincy, Somsen, Tindahay, and Vining series. These soils are on low terraces and basalt plains. They have a surface layer of loamy sand and sandy loam and are more than 20 inches deep to sand, gravelly sand, or bedrock. Slopes are 0 to 12 percent.

The adapted deciduous trees are black locust, hybrid poplar, green ash, and Russian-olive. Adapted shrubs are caragana (Siberian pea), southernwood, Nanking cherry, and lilac. The adapted evergreens are Rocky Mountain juniper, Scotch pine, and Austrian pine.

Because these soils have low available water capacity and rapid permeability, a high degree of irrigation water management is required for successful establishment of trees and shrubs. Water erosion caused by irrigation is a hazard in the more strongly sloping areas. Wind erosion is a hazard in spring. Site preparation for windbreak plantings should include leaving the surface rough, adding manure or a green-manure crop, and frequently irrigating to control wind erosion.

#### WINDBREAK GROUP 76

This group consists of somewhat poorly drained, mostly neutral to moderately alkaline soils of the Abo, Arloval, Decker, Maxey, Schodson, and Wodskow series. These soils are on low terraces. They have a surface layer of loamy sand, sandy loam, loam, loamy fine sand, or fine sandy loam and are more than 20 inches deep to sand or gravelly sand. They have a fluctuating high water table in summer. Slopes are 0 to 4 percent.

The adapted deciduous trees are golden willow, Russian-olive and hybrid poplar. Adapted shrubs are willow and Russian-olive, both of which should be pruned the first and second seasons of growth to promote dense branching. The adapted evergreens are lodgepole pine, Northern white cedar, and Norway spruce.

The fluctuating high water table during the irrigation season reduces the choice of trees and shrubs that can be grown.

### Use of the Soils for Wildlife<sup>3</sup>

Most soils in the Minidoka Area are suited to and support one or more kinds of wildlife. Chukars, mourning doves, ducks, geese, gray partridges, ring-necked

pheasants, California quail, sage grouse, and many non-game birds live in the survey area. Antelope and deer are big-game animals that inhabit the survey area. Muskrats are fur-bearing animals that inhabit streams, ponds, and irrigation ditches. Coyotes and bobcats are in many parts of the survey area, and fish live in the reservoirs, ponds, and streams.

Most wildlife species cannot be related directly to an individual soil or group of soils. Instead, each significant kind of wildlife is related to its important foods, cover (generally plants), and water. The development of these elements of each animal's habitat is dependent on the suitability as well as the use of the soil.

The nearest office of the Soil Conservation Service maintains specific, up-to-date technical guides for each important kind of wildlife and fish and for each significant plant that provides food or cover for wildlife. It also has specifications for establishment and maintenance of each soil and water conservation practice that is suited to the soils and water in the survey area. Thus, practical help can be obtained in planning and establishing food supply and habitat for wildlife.

In the following paragraphs, the foods, kinds of cover, and water areas that support important specified kinds of wildlife in the survey area are discussed and the soil associations that provide favorable habitat are indicated.

*Ring-necked pheasant.*—This game bird, a native of China, was successfully introduced into Idaho in the 1930's. Choice foods from plants are the seeds of barley, barnyardgrass, bristlegrass, corn, millet, oats, pigweed, Indian ricegrass, grain sorghums, teasel, and wheat. Among the fair foods are alfalfa, Kentucky bluegrass, chokecherry, clovers, currants, dandelion, raspberry, rose, Russian-olive, serviceberry, and sunflower. This bird also eats grasshoppers and other insects. The best habitat is diversified cropland and adjacent areas that provide cover made up of cattails, grassy ditches, and the shrubs or trees along fencerows and streams.

Soils in all the associations, except for the Trevino-Portino association, are well suited and can provide favorable habitat for the pheasant.

*Chukar.*—This game bird was introduced from southern Asia. Choice foods from plants are barley, bristlegrass, mountain brome, cheatgrass, clover, corn, currants, oats, pigweed, Indian ricegrass, serviceberry, grain sorghums, sunflowers, and wheat. Fair foods are alfalfa, barnyardgrass, Kentucky bluegrass, chokecherry, millets, potato, rose, and teasel. It also eats many insects. Its cover needs are met largely by rocky slopes and steep, grassy terrain.

Soils of the Somsen-Vining, Tindahay-Quincy, Schodson-Arloval-Maxey, Wodskow-Decker-Abo, and Vining-Escalante-Quincy associations provide suitable habitat for large numbers of chukars.

*Gray partridge.*—This European game bird, also called Hungarian partridge, was introduced about 1930. Its habitat is related closely to grain fields and range. Choice foods from plants are barley, barnyardgrass, bristlegrass, millets, grain sorghums, teasel, and wheat. Fair foods are alfalfa, cheatgrass, corn, dandelion, oats, pigweed, Indian ricegrass, rose, rye, sunflower, and timothy. Gray partridges also eat insects. Among the plants that provide

<sup>3</sup> By CLYDE A. SCOTT, biologist, Soil Conservation Service.

nesting cover are alfalfa, grass along fencerows, and patches of weeds.

Habitat for the gray partridge can be maintained or developed on the soils of all the associations.

*Sage grouse*.—Choice foods of this bird are alfalfa, clover, dandelion, prickly lettuce, sagebrush, salsify, serviceberry, and sunflower. Fair foods are biscuitroot, sweetclover, rose, and skunkbush. Sage grouse also eat ants, grasshoppers, and other insects. Range made up of sagebrush, grass, and forbs is basic habitat for sage grouse, but seasonal requirements vary.

Soils of the Portneuf-Portino-Trevino, Minidoka-Portneuf, Trevino-Portino, and Portino-Portneuf associations are suited to the plants that provide food and cover for the sage grouse.

*California quail*.—The choice foods of this native game bird, which is also called valley quail, are chiefly seeds. Tender green forage or fruit from barley, barnyardgrass, Kentucky bluegrass, chokecherry, corn, millets, oats, pigweed, raspberry, Indian ricegrass, grain sorghums, sunflower, teasel, and wheat are also important. Among the fair foods are alfalfa, bristlegrass, cheatgrass, clovers, dandelion, black locust, rose, Russian-olive, and timothy. This quail roosts in shrubs and trees and uses shrubby thickets for daytime cover.

Soils in all the associations are suited to plants that provide food and cover for the California quail.

*Mourning dove*.—This migratory game bird eats only seeds. Choice food plants are barnyardgrass, bristlegrass, reed canarygrass, corn, geranium, millets, pigweed, pine seed, ragweed, rape, Indian ricegrass, grain sorghums, sunflower, and wheat. Fair foods are barley, oats, rye, and vetch. Black locust and orchard trees are favorite nesting sites, although doves also nest in other trees and, in well-drained sites, on the ground. Doves need drinking water daily.

Dove habitat can be maintained or developed in all the soil associations of the Minidoka Area.

*Geese*.—A substantial population of Canada geese migrates along the Snake River, and large concentrations of them are near Lake Walcott. Their foods are from plants. Tender green grazing forage is important and may be found in alfalfa, barley, Kentucky bluegrass, clover, dandelion, sago pondweed, rye, timothy, and wheat. Other choice foods from plants are the seeds of alfalfa, barnyardgrass, corn, millets, rye, grain sorghum, and wheat. Fair foods include bulrush, cheatgrass, oats, pigweed, and smartweed.

Soils of general soil areas along the Snake River and around reservoirs provide nesting and resting habitat. Soils in most general soils areas of the survey area provide food for geese in fields of grain and green forage.

*Ducks*.—The surface-feeding ducks—mallard, pintail, widgeon—are found close to field grains and aquatic habitat. Summer foods include animal matter. Winter foods are chiefly plant seeds and green forage. Among the choice foods are barley, barnyardgrass, bulrush, corn, millets, sago pondweed, smartweed, grain sorghums, and wheat. Fair foods are clovers, dandelion, peas, and oats. Ducks are attracted most readily to seeds covered by shallow water. Nesting success is related to the aquatic habitat of marshes, lakes, and ponds, and important soils

are those suitable for water impoundment and management.

Soils of the Somsen-Vining, Tindahay-Quincy, Schodson-Arloval-Maxey, Wodskow-Decker-Abo, Vining-Escalante-Quincy, and Portneuf associations are most suitable for maintenance and development of food, such as grainfields, and water for ducks. Soils suitable for shallow-water impoundments and feeding areas are those near the Snake River and the canals, sloughs, and numerous drainage ditches. Lake Walcott is an example of a large water impoundment that provides food and nesting for ducks.

*Nongame birds*.—Many kinds of nongame birds live in the survey area. Numerous and varied shore birds find habitat along the river. Robins and other songbirds eat insects, worms, and fruit. Flycatchers, hawks, herons, and swallows live almost entirely on animal foods, such as fish, frogs, insects, rodents, and snakes. A few have a diet of weed seeds and grains, and some include animal foods, fruits, and seeds in their diet. All these foods, however, are derived directly or indirectly from the soils, plants, and waters of the survey area.

Soils in all the associations provide suitable food and habitat cover for one or more nongame species.

*Antelope*.—The foods eaten by antelope, on a year-long basis, are about 64 percent browse, 32 percent forbs, and 4 percent grass. Choice foods are alfalfa, aster, balsamroot, barley, bitterbrush, Kentucky bluegrass, clover, dandelion, hawksbeard, mountain-mahogany, Indian ricegrass, rye, sagebrush, salsify, four-wing saltbrush, shadscale saltbrush, serviceberry, sweetclover, birdsfoot trefoil, and wheat. Fair foods are biscuitroot, brome, burnet, shrubby cinquefoil, umbrella eriogonum, Idaho fescue, greasewood, oats, Oregongrape, rabbitbrush, rose, sunflower, wheatgrass, willows, and winterfat.

Antelope inhabit grassland, sagebrush range, and grain and hay fields. Intensity of use of these different kinds of habitat is determined by season. Grassland is used extensively during all seasons except winter; sagebrush range has its highest use during winter. The grainfields receive greatest use during fall and winter, and alfalfa fields are used extensively during summer. Antelope rely on good eyesight and speed, rather than on escape cover, for protection from predators.

Antelope require water, which is often provided by livestock ponds and spring developments. Construction of ponds and other water developments in areas of range has extended the range of antelope.

Soils of the Portneuf-Portino-Trevino, Minidoka-Portneuf, Trevino-Portino, and Somsen-Vining associations provide suitable habitat for antelope.

*Deer*.—Mule deer have seasonal variation in their choice of foods. Browse is preferred throughout summer and fall and early in winter. Grass makes up much of their diet late in winter and in spring.

Deer inhabit scattered areas throughout the Minidoka Area, but they are more concentrated along the river.

Soils of the Somsen-Vining, Tindahay-Quincy, Schodson-Arloval-Maxey, Wodskow-Decker-Abo, and Vining-Escalante-Quincy associations can provide suitable habitat for deer.

*Other game and fur-bearing animals*.—Muskrats are common in many parts of the survey area. They are

important fur-bearing animals and are in most of the streams, ponds, and irrigation ditches.

Bobcats and coyotes are predatory animals found in all general soil areas.

*Fish.*—The principal game fish in the ponds, streams, and reservoirs of the Minidoka Area are trout. All permanent streams, ponds, and lakes are suitable for fish. Trout production occurs in streams that are adequate in size, have a gravel bottom, and are not polluted. The Snake River and Lake Walcott are stocked regularly with trout.

## Engineering Uses of the Soils <sup>4</sup>

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, and systems for storing water, controlling erosion, draining soils, and disposing of sewage. Among the soil properties most important in engineering are permeability, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related properties of the soils is given in tables 3, 4, and 5. The estimates and interpretations of soil properties in these tables can be used to—

1. Make soil and land-use studies that will aid in selecting and developing industrial, commercial, residential, and recreational sites.
2. Make preliminary estimates of the soil properties that are important in planning drainage systems, farm ponds, irrigation systems, dikes, and waterways.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of road and highway construction material.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing structures and in planning certain engineering practices.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other sources for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed

because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many terms commonly used in soil science.

## Engineering classification systems

Three systems of classifying soils are used. One is the classification used by the U.S. Department of Agriculture and the other two are in general use among engineers.

The system of soil classification used by the U.S. Department of Agriculture is based partly on soil texture. In some ways it is comparable to the two systems used by engineers.

The American Association of State Highway Officials (AASHO) has developed a classification based on the field performance of soils (1). In this system, classification is based on gradation, liquid limit, and plasticity index. The performance of materials for highway construction has been related to this system of classification. All soil materials are classified in seven principal groups. The groups range from A-1, in which are gravelly soils of high bearing capacity, or the best soils for subgrade, to A-7, in which are clayey soils that have low strength when wet, or the poorest soils for subgrade. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The group index number is shown in parentheses after the soil group symbol in table 3.

Some engineers use the Unified soil classification system established by the Waterways Experiment Station, Corps of Engineers (11). This system is based on identification of soils according to their texture, plasticity, and performance as engineering construction material. Soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic. In the Unified system, the symbols SM and SC represent sands that contain fines of silt and clay; ML and CL, silts and clays of low liquid limit; and GP and GM, gravels and gravel-sand mixtures. Some soil materials have characteristics that are between major classes and are given a borderline classification, such as ML-CL.

## Engineering test data

Soil samples from three important soils of the Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties, were tested by the Bureau of Public Roads in accordance with the AASHO procedures to aid in evaluating soils for engineering purposes. The location of these sample sites, the depth of sampling, and results of the tests are shown in table 3.

Mechanical analysis shows the percentages, by weight, of soil particles that pass sieves of specified sizes. Sand and other coarser materials do not pass through the No. 200 (0.074 millimeter) sieve. Silt and clay pass through the No. 200 sieve. In the AASHO system, silt consists of material finer than 0.074 millimeter and coarser than 0.005 millimeter and clay of material finer than 0.005

<sup>4</sup>DALE SCHLADER, engineer, and David Van Houten, soil scientist, helped prepare this section.

TABLE 3.—*Engineering*

[Tests performed by Bureau of Public Roads in accordance with standard

Soil name and location	Parent material	Depth from surface	Mechanical analysis <sup>1</sup>	
			Percentage passing sieve—	
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
Kimama silt loam: 1,055 feet S. and 200 feet W. of NE. corner NW¼ sec. 18, T. 8 S., R. 26 E.	Alluvium derived from loess.	In. 0-4 8-17 33-43	----- ----- -----	----- ----- -----
Minidoka silt loam: 186 feet N. and 345 feet E. of well in SE. corner of NW¼SW¼ sec. 7, T. 7 S., R. 25 E.	Loess on undulating basalt upland.	0-10 17-24	----- 97	100 94
Quincy sand: 365 feet S. and 175 feet W. of NE. corner SE¼NE¼ sec. 10, T. 9 S., R. 23 E.	Eolian sand.	0-10 24-64	----- -----	100 100

<sup>1</sup> Mechanical analyses according to the AASHO Designation T 88 (1). Results by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes of soil.

TABLE 4.—*Estimated soil properties*

An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of this table.

Soil name and map symbols	Depth to—		Depth from surface (typical profile)	Classification			Coarse fraction greater than 3 inches
	Bed-rock	Seasonal high water table		Dominant USDA texture	Unified	AASHO	
Abo: Aa, Ab, Ac, Ae-----	<i>Ft.</i> >5	<i>Ft.</i> 2-4	<i>In.</i> 0-9	Loam-----	ML or CL	A-4 or A-6	-----
			9-19	Clay loam-----	ML-CL or CL	A-4 or A-6	-----
			19-51	Loam-----	ML or CL	A-4 or A-6	-----
			51-60	Sand-----	SP to SM	A-1	-----
Abo, alkali variant: Ak-----	>5	3-4	0-2 2-10	Silt loam----- Clay loam-----	ML-CL ML-CL to CL	A-4 A-6 or A-7	----- -----
			10-16 16-47	Loam----- Stratified sandy loam, loamy fine sand, fine sandy loam.	ML-CL SM to SC	A-4 A-4 or A-2	----- -----
Arloval: Ar, As-----	>5	2-3	0-52	Loamy fine sand-----	SM	A-2	-----
Clems: Ce-----	>5	>5	0-62	Sandy loam and loamy sand.	SM	A-4 or A-2	-----

*test data*

procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis <sup>1</sup> —Continued					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Con.		Percentage smaller than—					AASHO <sup>2</sup>	Unified <sup>3</sup>
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
-----	95	85	33	24	30	8	A-4(8)	ML-CL
-----	95	87	33	24	34	13	A-6(9)	CL
-----	98	93	27	22	31	9	A-4(8)	ML-CL
99	91	85	27	19	26	5	A-4(8)	ML-CL
89	73	67	24	17	28	6	A-4(8)	ML-CL
89	5	4	4	3	<sup>5</sup> NP	<sup>5</sup> NP	A-3(0)	SP-SM
89	2	2	2	2	NP	NP	A-3(0)	SP

<sup>2</sup> Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49 (1).

<sup>3</sup> Based on MIL-STD-619B (11).

<sup>4</sup> 99 percent passed the ¾-inch sieve.

<sup>5</sup> NP=Nonplastic.

*significant to engineering*

Such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions. The symbol > means more than; the symbol < means less than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to uncoated steel <sup>1</sup>
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
100	90-100	80-100	60-80	<i>In./hr.</i> 0.6-2.0	<i>In./in. of soil</i> 0.16-0.18	<i>pH value</i> 7.4-7.8	None in Aa and Ab. Low in Ac and Ae.	Moderate-----	High in Aa and Ab. Very high in Ac and Ae.
100	90-100	90-100	70-85	0.2-0.6	0.19-0.21	7.4-7.8	None in Aa and Ab. Low in Ac and Ae.	Moderate to high.	High in Aa and Ab. Very high in Ac and Ae.
100	90-100	80-100	60-80	0.6-2.0	0.16-0.18	7.4-8.4	None in Aa and Ab. Low in Ac and Ae.	Moderate-----	High in Aa and Ab. Very high in Ac and Ae.
100	80-90	40-50	0-15	6.0-20.0	0.05-0.07	-----	None-----	Very low-----	High.
100	90-100	90-100	80-90	0.6-2.0	0.19-0.21	7.4-7.8	Moderate-----	Moderate-----	Very high.
100	90-100	90-100	70-85	0.06-0.2	0.19-0.21	7.9-9.4	Moderate-----	Moderate to high.	Very high.
100	90-100	90-100	60-80	0.6-2.0	0.16-0.18	>9	Moderate-----	Moderate-----	Very high.
90-100	90-100	65-80	5-45	2.0-6.3	0.11-0.13	8.5-9.2	Low-----	Low-----	Very high.
90-100	90-100	50-70	15-25	6.3-20.0	0.09-0.11	7.4-7.8	None-----	Low-----	High.
100	90-100	50-70	25-45	2.0-6.3	0.11-0.13	7.4-7.8	None-----	Low-----	Moderate.

TABLE 4.—*Estimated soil properties*

Soil name and map symbols	Depth to—		Depth from surface (typical profile)	Classification			Coarse fraction greater than 3 inches
	Bed-rock	Seasonal high water table		Dominant USDA texture	Unified	AASHO	
Decker: Dc, Dd, De, Dk.....	<sup>Ft.</sup> >5	<sup>Ft.</sup> 2-4	<sup>In.</sup> 0-29	Loam.....	ML-CL or ML	A-4	-----
			29-51	Sandy loam, loam.....	SM	A-4	-----
			51-65	Stratified fine sand, silt loam, and gravelly sand.	SW-SM, SM, or SM-SC	A-1	-----
Declo: D/A, DmA, DmB, DmC..	>5	>5	0-24 24-60	Loam..... Loam and very fine sandy loam.	ML-CL or ML ML	A-4 A-4	----- -----
Escalante: EsA, EsB, EsC....	>5	>5	0-50	Fine sandy loam and loamy fine sand.	SM	A-2	-----
Feltham: FeB, FeC.....	>5	>5	0-58	Loamy sand and sandy loam.	SM	A-2 or A-4	-----
			58-66	Gravelly coarse sand.....	SW, SP, or SW-SM	A-1	-----
Kecko: KcB, KeA, KeB.....	<sup>2</sup> >5	>5	0-67	Stratified fine sandy loam, loam, loamy sand, and silt loam.	SM	A-2 or A-4	-----
Kimama: Km.....	>5	>5	0-64	Silt loam.....	ML to CL	A-4 or A-6	-----
Maxey: Ma.....	>5	2-3	0-26 26-38 38-63	Loamy fine sand..... Sandy loam..... Stratified loam, sandy loam, loamy sand, and silt loam.	SM-SC SM-SC SM, SC, or ML	A-2 A-4 A-2 or A-4	----- ----- 0-55
Minidoka: MkA, MkB, MkC, MkD.	2-3	>5	0-10 10-24 24-36	Silt loam..... Silt loam..... Hardpan.	ML-CL ML-CL or ML	A-4 A-4	----- 5-10
Paulville: Pa, Pd, Pe, Pm.....	>5	>5	0-42	Loam, heavy loam, and silt loam.	ML-CL or CL	A-4 or A-6	-----
			42-47	Loamy fine sand and fine sand.	SM or SP, SM	A-2 or A-4	0-5
Paulville, clayey subsoil variant: Pn, Pr.	>5	>5	0-38	Silty clay loam or silty clay.	CL or CH	A-7 or A-6	-----
			38-60	Silt loam.....	ML to CL	A-4 or A-6	-----
Portino: PsA, PsB, PsC, PsD..	2-3	>5	0-28 28	Silt loam and loam..... Bedrock.	ML-CL or ML	A-4	0-5
*Portneuf: PvA, PvB, PvC, PvD, PwE. For Trevino part of PwE, see Trevino series.	>4	>5	0-64	Silt loam.....	ML-CL or ML	A-4	-----
Quincy: QsD, QuB, QuC, QwD.. Properties of Rock outcrop part of QwD are too variable to be estimated.	>4	>5	0-79	Sand.....	SP-SM or SP	A-3	-----
*Rock outcrop: RtE. Mostly outcrop of basalt bedrock, but properties are too variable to be estimated. For Trevino part of this unit, see Trevino series.							

## significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to uncoated steel <sup>1</sup>
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
100	90-100	75-90	60-80	In./hr. 0.6-2.0	In./in. of soil 0.16-0.18	pH value 7.9-9.0	None in Dc and De. Slight or moderate in Dd and Dk.	Low-----	High.
100	90-100	50-70	35-45	2.0-6.3	0.11-0.13	7.9-8.4	None in Dc and De. Slight or moderate in Dd and Dk.	Low-----	High.
75-100	50-70	40-50	5-20	2.0-6.3	0.11-0.13	7.9-8.4	None-----	Low-----	High.
100 100	100 90-100	90-100 90-100	60-80 50-60	0.6-2.0 2.0-6.3	0.16-0.18 0.09-0.11	7.4-7.8 7.9-8.4	None----- None-----	Moderate----- Low-----	High. High.
100	100	85-100	25-35	2.0-6.3	0.13-0.15	7.4-8.4	None-----	Low-----	High.
90-100	100	60-80	15-40	6.0-20.0	0.08-0.10	7.4-8.4	None-----	Low-----	Moderate.
50-80	30-65	15-45	0-10	>20.0	0.04-0.06	-----	None-----	Low-----	High.
100	90-100	70-85	25-45	2.0-6.0	0.13-0.15	7.4-8.4	None-----	Low-----	High.
100	100	100	85-100	0.6-2.0	0.19-0.21	6.1-8.4	None-----	Moderate-----	High.
90-100 100 90-100	90-100 100 85-100	75-90 50-70 70-90	15-25 35-45 30-65	6.3-20.0 2.0-6.3 2.0-6.3	0.09-0.11 0.11-0.13 0.13-0.15	6.6-7.3 7.9-8.4 7.9-8.4	None----- None----- None-----	Low----- Low----- Low-----	High. High. High.
100 95-100	100 90-100	95-100 85-95	85-95 60-80	0.6-2.0 0.6-2.0	0.19-0.21 0.19-0.21	7.9-8.4 7.9-8.4	None----- None-----	Moderate----- Moderate-----	High. Very high.
100	90-100	70-90	65-85	0.2-0.6	0.18-0.20	7.4-8.4	None-----	Moderate to high.	High.
90-100	85-100	50-70	25-40	6.3-20.0	0.07-0.09	7.9-8.4	None-----	Low-----	High.
100	95-100	90-100	85-100	0.06-0.2	0.18-0.20	7.4-8.4	None-----	High-----	High.
100	100	95-100	90-100	0.6-2.0	0.19-0.21	7.9-8.4	None-----	Moderate-----	High.
95-100	95-100	90-100	70-85	0.6-2.0	0.18-0.20	7.9-8.4	None-----	Moderate-----	High.
100	100	95-100	85-100	0.6-2.0	0.19-0.21	7.4-8.4	None-----	Moderate-----	High.
95-100	90-100	70-90	0-10	6.3-20.0	0.05-0.07	7.9-8.4	None-----	Low-----	Moderate.

TABLE 4.—*Estimated soil properties*

Soil name and map symbols	Depth to—		Depth from surface (typical profile)	Classification			Coarse fraction greater than 3 inches
	Bed-rock	Seasonal high water table		Dominant USDA texture	Unified	AASHO	
	<i>Ft.</i>	<i>Ft.</i>	<i>In.</i>				
Rock land: Rk. 50 to 90 percent basalt rock outcrop; interspersed soil material too variable to be estimated.							
Schodson: Sc, Sd, Sh-----	>5	2-3	0-25	Sandy loam-----	SM	A-2 or A-4	-----
			25-50	Loamy coarse sand and coarse sand.	SW-SM, SM, or SC	A-1 or A-2	-----
*Somsen: SmB, SmC, SnB, SnC, SoE, SvE. Properties of Rock outcrop part of SoE are too variable to be estimated. For Vining part of SvE, see Vining series.	2-3	>5	0-24 24	Very stony and cobbly fine sandy loam. Bedrock.	SM or ML	A-2 or A-4	10-25
Taunton: TaB-----	2-3	>5	0-20 20	Light sandy loam----- Hardpan.	SM	A-2 or A-4	0-10
Tindahay: Td, Th-----	>5	>5	0-23 23-60	Sandy loam----- Loamy coarse sand and gravelly coarse sand.	SM SP-SM	A-2 or A-4 A-1 or A-3	-----
*Trevino: TpE, TrE----- For Portneuf part of TpE, see Portneuf series. Properties of Rock outcrop part of TrE are too variable to be estimated.	1-2	>5	0-15 15	Silt loam and stony silt loam. Bedrock.	ML	A-4	5-15
*Vining: VIB, VIC, VnB, VoE, VrE, VsE. For Quincy part of VoE, see Quincy series. For Somsen part of VsE, see Somsen series. Properties of Rock outcrop part of VrE and VsE are too variable to be estimated.	2-3	>5	0-27 27	Very stony and cobbly fine sandy loam and sandy loam. Bedrock.	SM	A-2 or A-4	5-25
Wheeler: WhD, WhF-----	>4	>5	0-66	Silt loam-----	ML-CL	A-4	-----
Wodskow: Wk, Wo-----	>5	2-4	0-55	Stratified sandy loam, loam, and loamy fine sand.	SM	A-2 or A-4	-----
			55-60	Sand-----	SP or SP-SM	A-1 or A-3	-----

<sup>1</sup> Corrosivity to concrete pipe is low for all the soils, except the Abo alkali variant soil where it is moderate.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to uncoated steel <sup>1</sup>
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
				<i>In./hr.</i>	<i>In./in. of soil</i>	<i>pH value</i>			
95-100	90-100	50-70	30-40	2. 0-6. 3	0. 11-0. 13	7. 9-8. 4	None in Sc and Sd. Slight or moderate in Sh.	Low-----	High in Sc and Sd. Very high in Sh.
90-100	90-100	40-60	10-25	6. 3-20. 0	0. 06-0. 08	7. 9-8. 4	None in Sc and Sd. Slight or moderate in Sh.	Low-----	High in Sc and Sd. Very high in Sh.
90-100	80-95	70-85	35-55	2. 0-6. 3	0. 13-0. 15	7. 4-8. 4	None-----	Low-----	High.
100	90-100	50-70	25-40	2. 0-6. 3	0. 11-0. 13	7. 4-7. 8	None-----	Low-----	High.
95-100 70-90	90-100 60-80	50-75 40-60	25-45 5-10	2. 0-6. 3 6. 3-20. 0	0. 11-0. 13 0. 04-0. 06	7. 4-7. 8 7. 9-8. 4	None----- None-----	Low----- Low-----	High. Moderate.
90-100	85-95	75-95	60-85	0. 6-2. 0	0. 19-0. 21	6. 6-7. 8	None-----	Moderate-----	High.
90-100	80-95	70-85	30-50	2. 0-6. 3	0. 11-0. 13	6. 6-7. 8	None-----	Low-----	Moderate.
100	100	100	90-100	0. 6-2. 0	0. 19-0. 21	7. 9-9. 0	None-----	Moderate-----	High.
95-100	90-100	70-95	25-45	0. 6-2. 0	0. 11-0. 13	7. 4-8. 4	None in Wk. Slight to mod- erate in Wo.	Low-----	High and very high.
80-100	70-100	40-70	0-10	6. 3-20. 0	0. 04-0. 06	7. 9-8. 4	None-----	Low-----	Very high.

<sup>2</sup> At this depth in most places.

TABLE 5.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that

Soil name and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Abo: Aa, Ab, Ac, Ae-----	Good in Aa and Ab. Fair in Ac and Ae: salts.	Good: seasonal high water table.	Fair: moderate to high shrink-swell potential; sea- sonal high water table.	Seasonal high water table; high sus- ceptibility to frost heave; slopes easily eroded.
Abo, alkali variant: Ak-----	Poor: salts-----	Unsuitable: silt loam and clay loam.	Fair to poor: moderate to high shrink-swell potential; seasonal high water table at a depth of 3 to 4 feet.	High susceptibility to frost heave; seasonal high water table.
Arloval: Ar, As-----	Poor: loamy sand; high water table.	Poor: loamy fine sand; seasonal high water table.	Good to fair: seasonal high water table.	High water table; high susceptibility to frost heave.
Clems: Ce-----	Good-----	Poor: sandy loam and loamy sand.	Good to fair: excess fines.	Moderate suscepti- bility to frost heave; slightly plastic.
Decker: Dc, Dd, De, Dk-----	Good in Dc and De. Fair in Dd and Dk: salts.	Fair or poor: loam and sandy loam; seasonal high water table.	Fair: seasonal high water table.	Seasonal high water table; moderate to high suscepti- bility to frost heave.
Declo: DIA, DmA, DmB, DmC-----	Good-----	Poor: loam and very fine sandy loam; underlain by sand or grav- elly sand in some areas.	Fair: moderate and low shrink-swell potential.	High susceptibility to frost heave; slopes easily eroded.
Escalante: EsA, EsB, EsC-----	Good-----	Poor: fine sandy loam and loamy fine sand; under- lain by sand or gravelly sand in some areas.	Good-----	Moderate suscepti- bility to frost heave.
Feltham: FeB, FeC-----	Poor: loamy sand--	Good: 3 feet of loamy sand over sand and gravel.	Good-----	Slight susceptibility to frost heave.
Keeko: KcB, KeA, KeB-----	Good where soil is very deep.	Poor: fine sandy loam, loam, silt loam.	Good-----	Moderate suscepti- bility to frost heave; slightly plastic.
Kimama: Km-----	Good-----	Unsuitable: silt loam.	Fair to poor: mod- erate shrink-swell potential.	High susceptibility to frost heave; slightly plastic; moderate permea- bility.

*interpretations of soils*

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Soil features affecting—Continued				Degree and kinds of limitations for—	
Pond reservoir area	Embankments	Drainage for crops and pasture	Irrigation	Dwellings with basements	Septic tank filter fields
Moderately slow permeability; seasonal high water table.	Medium to low stability; medium to low permeability; low to high piping hazard.	Some depressions are lower than available outlets.	Available water capacity 8 to 10 inches.	Severe: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
Slow permeability in upper 10 inches; seasonal high water table.	Medium to low stability; medium to low permeability; low to high piping hazard.	Suitable outlets are difficult to find.	Available water capacity 8 to 10 inches; moderate to slight salinity and alkali.	Severe: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
Rapid permeability; seasonal high water table.	Medium stability; medium to low permeability; medium to high piping hazard.	Some depressions are lower than available outlets.	Available water capacity 5 to 7 inches.	Severe: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
Moderately rapid permeability.	Medium stability; medium to low permeability; medium to high piping hazard.	Not needed-----	Available water capacity 6 to 7 inches.	Slight-----	Slight. <sup>1</sup>
Moderate permeability; seasonal high water table.	Medium stability; low permeability; medium to low piping hazard.	Suitable surface outlets are difficult to find.	Available water capacity is 7 to 9 inches; level or nearly level soils.	Severe: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
Moderate permeability.	Medium to low stability; medium to low permeability; high piping hazard.	Not needed-----	Available water capacity is 9 to 11 inches; moderate to high hazard of erosion in the more strongly sloping areas.	Moderate: hazard of frost heave.	Slight.
Moderately rapid permeability; high seepage loss.	Medium stability; medium to high piping hazard; medium to low permeability.	Not needed-----	Available water capacity is 7 to 9 inches; water erosion is a hazard in the more strongly sloping areas.	Moderate: hazard of frost heave.	Slight.
Moderately rapid permeability; positive cutoff a difficulty.	Medium stability; medium to high piping hazard; medium to low permeability.	Not needed-----	Available water capacity is 4 to 6 inches; wind erosion is a hazard.	Slight-----	Slight. <sup>1</sup>
Moderate permeability.	Medium stability; medium to high piping hazard; medium to low permeability.	Not needed-----	Available water capacity is 7 to 9 inches; wind erosion is a hazard.	Moderate: hazard of frost heave.	Slight. <sup>1</sup> Severe if bed-rock is at depth of less than 48 inches.
Moderate permeability.	Medium to low stability; medium to low permeability; high piping hazard.	Not needed-----	Available water capacity is 11 to 12 inches.	Moderate: low shrink-swell potential.	Moderate: moderate permeability.

TABLE 5.—Engineering

Soil name and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Maxey: Ma-----	Poor: loamy fine sand.	Fair to poor: underlain by sand or gravelly sand in some areas; seasonal high water table.	Fair: seasonal high water table.	Low susceptibility to frost heave; seasonal high water table.
Minidoka: MkA, MkB, MkC, MkD-----	Poor: indurated hardpan at depth of 2 to 3 feet.	Unsuitable: silt loam.	Poor: moderate shrink-swell potential; moderately deep to hardpan.	High susceptibility to frost heave; slightly plastic; indurated hardpan at depth of 2 to 3 feet.
Paulville: Pa, Pd, Pe, Pm-----	Good in Pd and Pe. Fair in Pm. Poor in Pa: unfavorable texture.	Fair to poor: gravel below depth of 40 inches in some areas.	Poor: moderate to high shrink-swell potential.	High susceptibility to frost heave; moderately plastic.
Paulville, clayey subsoil variant: Pn, Pr--	Fair to depth of 8 inches. Poor below that depth: silty clay.	Unsuitable: silty clay loam and silty clay.	Poor: moderate to high shrink-swell potential.	High susceptibility to frost heave; plastic subsoil.
Portino: PsA, PsB, PsC, PsD-----	Poor: bedrock at depth of 2 to 3 feet.	Unsuitable: silt loam and loam.	Poor: bedrock at depth of 2 to 3 feet.	High susceptibility to frost heave; slightly plastic; bedrock at depth of 2 to 3 feet.
*Portneuf: PvA, PvB, PvC, PvD, PwE--- For Trevino part of PwE, see Trevino series.	Good-----	Unsuitable: silt loam.	Fair: moderate shrink-swell potential.	High susceptibility to frost heave; slightly plastic.
*Quincy: QsD, QuB, QuC, QwD----- Properties of Rock outcrop part of QwD are too variable to be estimated.	Poor: available water capacity is 2.5 to 4.5 inches.	Fair for sand: some fines. Unsuitable for gravel.	Good material if soil binder is added.	Low susceptibility to frost heave; severe equipment and travel limitations through duny areas.
Rock land: Rk. Too variable to be estimated.				
*Rock outcrop: RtE. Properties are too variable to be estimated. For Trevino part, see Trevino series.				

*interpretations of soils—Continued*

Soil features affecting—Continued				Degree and kinds of limitations for—	
Pond reservoir area	Embankments	Drainage for crops and pasture	Irrigation	Dwellings with basements	Septic tank filter fields
Rapid permeability to depth of 26 inches; moderately rapid permeability below; seasonal high water table.	Medium to low stability; low to high piping hazard; medium to low permeability.	Suitable outlets are difficult to find.	Available water capacity is 6 to 7 inches; wind erosion is a hazard.	Moderate: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
2 to 3 feet of moderately permeable soil material over indurated hardpan.	Medium to low stability; medium to low permeability; high piping hazard; bedrock at depth of 2 to 3 feet.	Not needed-----	Available water capacity is 5 to 7.5 inches above hardpan; moderately deep to indurated hardpan; water erosion is a hazard in the more strongly sloping areas.	Severe: hardpan at depth of 2 to 3 feet; bedrock underlies hardpan in some areas.	Severe: indurated hardpan below depth of 2 to 3 feet.
Moderately slow permeability to depth of 2 inches, rapid permeability below that depth.	Medium to low stability; medium to low permeability; high piping hazard.	Not needed-----	Available water capacity is 8 to 10 inches; wind erosion is a hazard on coarse-textured soils.	Moderate or severe: moderate to high shrink-swell potential.	Slight. <sup>1</sup>
Slow permeability---	Low to medium stability; low permeability; low piping hazard.	Drainage difficult because of low permeability and hazard of flooding; surface outlets difficult to find.	Available water capacity is 10 to 12 inches; slow intake rate.	Moderate or severe: moderate or high shrink-swell potential.	Severe: slow permeability.
2 to 3 feet of moderately permeable soil material over bedrock.	Medium to low stability; medium to low permeability; high piping hazard; bedrock at depth of 2 to 3 feet.	Not needed-----	Available water capacity is 4.5 to 7 inches above the bedrock; water erosion is a hazard in the more strongly sloping areas.	Severe: bedrock at depth of 2 to 3 feet.	Severe: bedrock at depth of 2 to 3 feet.
Deep; moderate permeability.	Medium to low stability; medium to low permeability; high piping hazard.	Not needed-----	Available water capacity is 8 to 12 inches; water erosion is a hazard in the more strongly sloping areas.	Moderate: moderate shrink-swell potential.	Moderate: moderate permeability.
Rapid permeability--	Medium stability; high permeability; medium piping hazard.	Not needed-----	Available water capacity is 2.5 to 4.5 inches; wind erosion is a hazard.	Slight-----	Slight. <sup>1</sup>

TABLE 5.—*Engineering*

Soil name and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Schodson: Sc, Sd, Sh-----	Good in Sc and Sd. Fair in Sh: salts.	Poor or fair for sand: seasonal high water table. Unsuitable for gravel.	Fair: seasonal high water table.	High susceptibility to frost heave; seasonal high water table.
*Somsen: SmB, SmC, SnB, SnC, SoE, SvE. Properties of Rock outcrop part of SoE are too variable to be estimated. For Vining part of SvE, see Vining series.	Poor: very stony; bedrock at depth of 2 to 3 feet.	Poor: bedrock at depth of 2 to 3 feet.	Poor: bedrock at depth of 2 to 3 feet.	Bedrock at depth of 2 to 3 feet; many rock outcrops in some areas.
Taunton: TaB-----	Poor: underlain by hardpan and bedrock at depth of 2 to 3 feet.	Poor: strongly cemented hardpan and bedrock at depth of 2 to 3 feet.	Poor: strongly cemented hardpan and bedrock are at depth of 2 to 3 feet.	Moderate susceptibility to frost heave; cemented hardpan and bedrock at depth of 2 to 3 feet.
Tindahay: Td, Th-----	Fair: underlain by sand and gravel.	Fair to good: loamy coarse sand and gravelly coarse sand.	Fair: moderate hazard of frost heave.	Moderate susceptibility to frost heave.
*Trevino: TpE, TrE----- For Portneuf part of TpE, see Portneuf series. Properties of Rock outcrop part of TrE are too variable to estimate.	Poor: bedrock at depth of 1 foot to 2 feet.	Unsuitable-----	Poor: bedrock at depth of 1 foot to 2 feet.	High susceptibility to frost heave; bedrock at depth of 1 foot to 2 feet.
*Vining: VIB, VIC, VnB, VoE, VrE, VsE. For Quincy part of VoE, see Quincy series; for Somsen part of VsE, see Somsen series. Properties of Rock outcrop part of VrE and VsE are too variable to estimate.	Poor: stones; bedrock at depth of 2 to 3 feet.	Poor: bedrock at depth of 2 to 3 feet.	Poor: bedrock at depth of 2 to 3 feet.	High susceptibility to frost heave; bedrock at depth of 2 to 3 feet; undulating topography.
Wheeler: WhD, WhF-----	Good-----	Unsuitable: silt loam.	Fair: moderate shrink-swell potential.	High susceptibility to frost heave.
Wodskow: Wk, Wo-----	Good in Wk. Fair in Wo: salts.	Fair: seasonal high water table.	Fair: seasonal high water table at depth of 2 to 4 feet.	High susceptibility to frost heave; seasonal high water table.

<sup>1</sup> Possible pollution of water supply.

*interpretations of soils—Continued*

Soil features affecting—Continued				Degree and kinds of limitations for—	
Pond reservoir area	Embankments	Drainage for crops and pasture	Irrigation	Dwellings with basements	Septic tank filter fields
Moderately rapid permeability to depth of 25 inches, rapid permeability below that depth; high seepage loss; seasonal high water table.	Medium stability; low permeability; medium piping hazard.	Suitable outlets are difficult to find.	Available water capacity is 4.5 to 6 inches; wind erosion is a hazard.	Severe: seasonal high water table.	Severe: seasonal high water table. <sup>1</sup>
Moderately rapid permeability; bedrock at depth of 2 to 3 feet.	Medium to low stability; subject to piping; limited volume of material; very stony and cobbly; bedrock at depth of 2 to 3 feet.	Not needed.....	Available water capacity is 3 to 4.5 inches; wind erosion is a hazard; water erosion is a hazard in the more strongly sloping areas.	Severe: bedrock at depth of 2 to 3 feet.	Severe: bedrock at depth of 2 to 3 feet.
Moderately rapid permeability; hardpan and bedrock at depth of 2 to 3 feet.	Medium stability; medium permeability; medium piping hazard; limited volume of material; hardpan and bedrock at depth of 2 to 3 feet.	Not needed.....	Available water capacity is 2.5 to 5.0 inches; moderately deep to hardpan.	Severe: bedrock at depth of 2 to 3 feet.	Severe: underlain by hardpan and bedrock.
Moderately rapid permeability to depth of 23 inches, rapid permeability below that depth; high seepage loss.	Medium stability; medium permeability; medium piping hazard.	Not needed.....	Available water capacity is 4.5 to 5.5 inches; wind erosion is a hazard.	Slight.....	Slight. <sup>1</sup>
Moderate permeability; 1 foot to 2 feet deep to bedrock.	Poor stability; subject to piping; possible seepage into bedrock crevices; limited volume of material available.	Not needed.....	Shallow to basalt bedrock.	Severe: bedrock at depth of 1 foot to 2 feet.	Severe: shallow to bedrock.
2 to 3 feet of soil material that has moderately rapid permeability and that overlies bedrock.	Medium stability; subject to piping; bedrock at depth of 2 to 3 feet.	Not needed.....	Available water capacity is 2.5 to 5 inches; wind erosion is a hazard; water erosion is a hazard in the more strongly sloping areas.	Severe: bedrock at depth of 2 to 3 feet.	Severe: bedrock at depth of 2 to 3 feet.
Deep; moderate permeability.	Medium to low stability; medium to low permeability; high piping hazard.	Not needed.....	Available water capacity is 8 to 12 inches; very high hazard of water erosion.	Moderate: moderate shrink-swell potential.	Moderate where slopes are as much as 15 percent. Severe where slopes are more than 15 percent.
Moderate permeability; seasonal high water table.	Medium stability; medium to high permeability; medium piping hazard; seasonal high water table.	Suitable surface outlets difficult to find.	Available water capacity is 5 to 7 inches; wind erosion is a hazard.	Severe: seasonal high water table at depth of 2 to 4 feet.	Severe: seasonal high water table. <sup>1</sup>

millimeter. Other systems use 0.05 millimeter and 0.002 millimeter values in describing silt and clay. The particle-size distribution of those materials passing the No. 200 sieve was determined by the hydrometer method rather than by the pipette method used by most soil scientists.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

### ***Estimated soil properties significant to engineering***

Table 4 lists the soils of the survey area alphabetically and shows the map symbols for mapping units. Where important differences in engineering properties occur among phases of soil series, the phases are entered separately in the table.

The dominant USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter.

Permeability, as used in table 4, relates only to movement of water downward through undisturbed and uncompacted soil and does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties that result from use of the soil are not considered.

Available water capacity is that amount of water in the soil available for plant growth after all free water has drained away.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Salinity of the soil is based on the electrical conductivity of the saturated soil extract, as expressed in millimhos per centimeter at 25° C. It affects the suitability of a soil for crops, its stability when used as a construction material, and its corrosiveness to other materials.

Shrink-swell potential is an indication of the volume change to be expected of soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Corrosivity, as used here, indicates the potential risk to uncoated steel through chemical action that dissolves or weakens the structural material. Structural material can corrode if buried in soil, and a given material corrodes more rapidly in some kinds of soil than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations made entirely in one kind of soil or soil horizon.

### ***Engineering interpretations of the soils***

Table 5 contains selected information useful to those

who plan to use soil material in construction of highways, farm facilities, buildings, and sewage disposal systems. Detrimental or undesirable features are emphasized, but very important desirable features also may be listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 4; on available test data, including those in table 3; and on field experience. While the information strictly applies only to soil depths indicated in table 4, it is reasonably reliable to a depth of 6 feet or more in some soils.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily high in content of organic matter, used as a topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Sand and gravel ratings are based on the probability that mapped areas of the soil contain deposits of sand and gravel. The ratings do not indicate quality or size of deposits.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for this purpose.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. The soil features, favorable as well as unfavorable, are the main ones that affect geographic location of highways.

Farm pond reservoir areas are affected mainly by seepage loss of water, and the soil features are those that influence such seepage.

Farm pond embankments serve as dams. The features of both the subsoil and the substratum are those important to the use of soils for constructing embankments. The permeability ratings in table 5 are for compacted soil.

Drainage for crops and pasture is principally concerned with soil permeability, depth to layers that influence the rate of water movement in soils (bedrock, sand, claypan, etc.), depth to water table, and topographic position.

Irrigation is the consideration of those features and qualities of soils that affect their suitability for irrigation. These are available water capacity, high water table, hazard of erosion, salinity and alkalinity, soil depth, and flooding. All farmed soils in the Minidoka Area are irrigated. Methods of water application vary with soils, topography, and custom. They include the corrugation, furrow, border, sprinkler, and wild flooding methods. Considerable work has been performed in recent years to improve the on-farm systems. This work includes land leveling, concrete ditch lining, water control structures, pipelines, and sprinkler systems. In spite of the fact that this work is continuing at a rapid rate, over-application of irrigation water is a serious problem. Labor costs of irrigation and the abundant water supply work against the principles of good water management.

Dwellings with basements are affected chiefly by features of the undisturbed soil that influence the capacity of the soil to support low buildings that have normal foundation loads.

Septic tank filter fields are affected mainly by permeability, depth to water table, and susceptibility to flooding. The degree of limitation and principal reasons for assigning it are given.

## Formation and Classification of the Soils

This section describes the factors of soil formation in the Minidoka Area and the classification of the soils by the current system. Table 6 gives the classification of the soils by higher categories.

### Factors of Soil Formation

Each soil is considered a natural body that has morphology resulting from the combined effect of climate, living matter, parent material, relief, and time. The morphology of each soil, as expressed in its profile, reflects the effect of the particular set of genetic factors responsible for its formation (10).

Soils differ in the various parts of the survey area because different factors are dominant. For example, sandy soils have very little profile development because the parent material is of relatively recent deposition and contains large grains of quartz that are highly resistant to weathering. These soils can be compared with soils that have distinct profile development because they had finer textured parent material that had been in place for a longer time and contained only a few large grains of quartz. As shown by this example of the interaction of parent material and time, soil-forming factors commonly interact with one another. Relief, which influences the microclimate, also interacts with other

factors, and changes in climate cause changes in kind and amount of living matter. Thus, relief, climate, and living matter may all be changing at the same time. How the five soil-forming factors have influenced soil formation in the Minidoka Area is discussed in the paragraphs that follow.

### Climate

Climate is relatively uniform throughout the Minidoka Area and is a major factor in the development of most of the soils. Weather information indicates that annual precipitation is about 9 or 10 inches. Most of the precipitation falls when soil temperature is lowest and the soil-forming processes are at their minimum. The low content of organic matter, light colors, and strong accumulation of lime near the surface in such soils as those of the Declo, Minidoka, Paulville, and Portneuf series indicate the relatively dry conditions under which they formed. In contrast, Kimama soils have higher content of organic matter, slightly darker colors, and lime at greater depth. These features indicate the relatively moist conditions in the low areas, which receive runoff from the surrounding higher areas and in which these soils formed. The formation of these soils was influenced by significant microclimate conditions.

The addition of irrigation water has affected soil formation because it has changed the soil climate for the major soils in this area.

TABLE 6.—*Soil series classified by higher categories*

Series	Family	Subgroup	Order
Abo.....	Fine-loamy, mixed, mesic.....	Aquic Haplargids.....	Aridisols.
Abo, alkali variant.....	Fine-loamy, mixed, mesic.....	Aquic Natrargids.....	Aridisols.
Arloval.....	Mixed, mesic.....	Typic Psammaquents.....	Entisols.
Clems.....	Coarse-loamy, mixed, mesic.....	Xerollic Camborthids.....	Aridisols.
Decker <sup>1</sup> .....	Fine-loamy, mixed, mesic.....	Aquic Calciorthids.....	Aridisols.
Declo.....	Coarse-loamy, mixed, mesic.....	Xerollic Calciorthids.....	Aridisols.
Escalante <sup>1</sup> .....	Coarse-loamy, mixed, mesic.....	Xerollic Calciorthids.....	Aridisols.
Feltham.....	Sandy, mixed, mesic.....	Xeric Torriorthents.....	Entisols.
Kecko.....	Coarse-loamy, mixed, mesic.....	Xerollic Camborthids.....	Aridisols.
Kimama.....	Fine-silty, mixed, mesic.....	Aridic Calcic Argixerolls.....	Mollisols.
Maxey.....	Sandy, mixed, mesic.....	Aquic Xerorthents.....	Entisols.
Minidoka.....	Coarse-silty, mixed, mesic.....	Xerollic Durorthids.....	Aridisols.
Paulville.....	Fine-loamy, mixed, mesic.....	Xerollic Haplargids.....	Aridisols.
Paulville, clayey subsoil variant.....	Fine, montmorillonitic, mesic.....	Xerollic Paleargids.....	Aridisols.
Portino <sup>1</sup> .....	Coarse-silty, mixed, mesic.....	Xerollic Calciorthids.....	Aridisols.
Portneuf.....	Coarse-silty, mixed, mesic.....	Durixerollic Calciorthids.....	Aridisols.
Quincy.....	Mixed, mesic.....	Xeric Torripsamments.....	Entisols.
Schodson.....	Coarse-loamy, mixed, nonacid, mesic.....	Aquic Xerorthents.....	Entisols.
Somsen.....	Coarse-loamy, mixed, mesic.....	Xerollic Calciorthids.....	Aridisols.
Taunton.....	Coarse-loamy, mixed, mesic.....	Xerollic Durorthids.....	Aridisols.
Tindahay.....	Sandy, mixed, mesic.....	Xeric Torriorthents.....	Entisols.
Trevino.....	Loamy, mixed, mesic.....	Lithic Xerollic Camborthids.....	Aridisols.
Vining.....	Coarse-loamy, mixed, mesic.....	Xerollic Camborthids.....	Aridisols.
Wheeler.....	Coarse-silty, mixed, calcareous, mesic.....	Xeric Torriorthents.....	Entisols.
Wodskow.....	Coarse-loamy, mixed, mesic.....	Aquic Camborthids.....	Aridisols.

<sup>1</sup> In this county these soils are taxadjuncts to the series for which they are named:

Decker soils are outside the defined range for their series because they average less than 18 percent clay at depths between 10 and 40 inches.

Most of the Escalante and Portino soils are outside the range defined for their series because, after mixing, they are noncalcareous in the upper 7 inches.

These differences do not affect the use or behavior of these soils.

### ***Living matter***

Living matter consisting of plant and animal life has a significant function in the process of soil formation. The kind and amount of vegetation that grows on a soil over a long period of time has a strong influence on the kind, amount, and position of organic matter in the soil. Low precipitation in this survey area has resulted in density of plant growth and, in turn, in limited amounts of organic matter added to the soil. Consequently, most soil colors are light. Plants provide a cover that controls erosion while the soil-forming processes take place. Wheeler and Quincy soils are among those that have been affected by sparse vegetation and unstable soil conditions resulting from low effective precipitation.

### ***Parent material***

Parent material is the unconsolidated layer on the earth's surface in which soils form. Most of the chemical and mineralogical composition is attributed to it. Eolian deposits and alluvium are the two major sources of parent material in the Minidoka Area, Parts of Minidoka, Blaine, and Lincoln Counties. Deposits of loess occupy the major part of the survey area and occur in the northern and western parts. This Area is part of the Snake River Plain, which is described as a structural depression that has filled mainly with basalt and related volcanic rock of Pliocene age or younger. The upper layer of basalt on this plain consists of flows of Pleistocene and Recent age (?). Deposits of loess cover the basalt in most places and are generally thickest in the west and thinnest in the east and northeast. Portneuf soils are the principal soils in areas of deep loess. The deposition of strongly calcareous loess during the past centuries and the subsequent leaching of carbonates have been the major factors in the formation of a distinct Cca horizon in Portneuf and associated soils. Soils of the Minidoka series, which is one of the important associated soil series, have an indurated hardpan formed by cementation with lime and silica. These soils are in the northern part of the loess-covered area where they are associated with old volcanos.

Eolian deposits that contain much sand cover the basalt in the areas around Acequia and immediately north of Lake Walcott. In these areas, the accumulation and the shifting of parent material have restricted the formation of such soil characteristics as dark color in the surface layer and distinct prismatic or blocky structure. They have also restricted the content of organic matter. Feltham and Quincy soils are examples of minimal soil formation in these areas.

The rest of the Minidoka Area, in the area around Rupert and Paul, is low alluvial terraces. Here the parent material is mainly alluvium deposited by the Snake River, but there are small areas of eolian deposition. Formation of the soils on the low terraces has been distinctly influenced by the stability, the stratification, and the particle size of the deposits. Paulville soils, which occur on the northwestern part of the terraces, formed in parent material laid down by slow-moving water. This material is somewhat stratified and contains more silt and clay than that in which most of the associated soils formed. Paulville soils have slightly more clay in the B horizon than the associated Declo

soils, which formed in slightly coarser textured deposits. The clayey subsoil variant of the Paulville series has a fairly thick, fine-textured subsoil, mainly because fine-textured parent material was deposited in that layer.

### ***Relief***

Relief in much of the Minidoka Area is level or undulating. A narrow strip between the low terraces and the loess-covered basalt plains is hilly, and the slopes have contributed to water erosion and lessened the effect of climate on soil formation. Here Wheeler soils are dominant. Only a little leaching of lime from their surface layer or a small accumulation of lime in their subsoil has taken place. Kimama soils occupy the drainageways on plains and some outwash fans on terraces. Here the relief is such that moisture is received from surrounding higher areas. Moisture and the resulting vegetation have influenced soil formation, and as a result, the soils have such characteristics as darker colors in the A1 horizon and greater depth to the Cca horizon.

In areas south of Paul and Rupert, drainage is restricted and the water table is highest during the irrigation season. Water eliminates air from the lower part of the soil and results in a low content of oxygen. Iron oxides that accumulate in the wet part of the soil give a mottled effect, as in the Arloval soils that have mottles just below the plow layer or within a few inches of it. These soils occupy slightly concave positions where the water table is commonly near the surface.

Where the water table is high enough, moisture reaches the soil surface through capillary action. As the soil moisture moves upward, it carries a variety of dissolved salts to the surface. As the moisture evaporates, a residue of these soluble salts is left in places on such soils as those of the Abo, Decker, Schodson, and Wodskow series. Depth to soluble salts varies with the season of the year, but the salts are generally at or near the surface late in summer and deeper in the profile after fall and winter moisture.

### ***Time***

Time as a factor in the formation of soils in the Minidoka Area has been relatively short and fairly uniform for most soils in the survey area. In such soils as Decker, Declo, and Portneuf soils, time has been a factor in limiting soil development. Structural and horizon development in the thin surface layer has been interrupted in most areas by recent plowing. Some soluble materials were leached from the surface layer and deposited in the subsoil. These are an indication of the degree of soil formation. Although Kimama soils formed in relatively recent deposits, they have received additional moisture that has resulted in more plant growth. The moisture and plant growth have contributed to their formation.

Time has had minor influence on Tindahay, Feltham, and Maxey soils. These soils formed in relatively recent and unstable parent material.

## **Classification of the Soils**

Classification consists of an orderly grouping of soils according to a system designed to make it easier to

remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and later revised (8). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (10) and was adopted in 1965 (6). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

In the following paragraphs are brief descriptions of the six categories of soil classification:

*Order.*—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histisols. The differentiating characteristics selected for the orders are based on the kind and degree of the dominant soil-forming processes that have taken place.<sup>5</sup> The soils in the Minidoka Area have been placed in three orders—Entisols, Aridisols, and Mollisols.

Entisols are mineral soils without or with very weakly expressed natural genetic (diagnostic) horizons.

Aridisols are mineral soils that formed primarily in dry places and have a light-colored surface layer and other genetic horizons that reflect low moisture conditions.

Mollisols are mineral soils that have a darkened surface layer and high base saturation.

*Suborder.*—Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and that are important to plant growth or were selected to reflect the most important variables within the order. Colors associated with wetness and saturation are characteristics used to define one suborder. In another suborder, soils are grouped because they are sandy throughout. In orders that have a wide range of climate, suborders group soils that have similarities in soil moisture and temperature. Soils of the Minidoka Area have been classified in six suborders.

*Great group.*—Most suborders are divided into more than one great group. Subdivisions are on the basis of kind, arrangement, and degree of expression of pedogenic horizons; close similarities in soil moisture and temperature; and base status. In the Minidoka Area the soils have been placed in twelve great groups.

*Subgroup.*—Great groups are divided into three kinds of subgroups. The typic, or central, concept of the great group; the intergrades or transitional forms to other orders, suborders, or great groups; and the extragrade subgroups that have some properties that are not representative of the great group but that do not indicate transitions to any other known kind of soil. These are intergrade subgroups that have properties most like that great group whose name they bear. In some cases the subgroups are intergrades to other suborders or orders. Extragrade subgroups have properties not indicative of any great group, suborder, or order. The soils of the Minidoka Area have been classified in subgroups.

*Family.*—The family groups soils within a subgroup that have physical and chemical properties similar enough that responses to management and use are nearly the same for comparable soil phases. Among these properties are texture and mineralogy of the subsoil, soil temperature, consistence, depth of soil, reaction, moisture equivalent, permanent cracks, and slope. There are 20 soil families represented in the classification of soils in the Minidoka Area.

*Series.*—The series is a group of soils essentially uniform in differentiating characteristics and in arrangement of horizons; or, if genetic horizons are thin or absent, a group of soils that, within defined depth limits, are uniform in soil properties diagnostic for differentiating a soil series.

## General Nature of the Area

According to estimates of population for the parts of Blaine and Lincoln Counties that are in the survey area and according to the 1964 census of Minidoka County, the population of the Minidoka Area is about 14,100.

Among the industries in the survey area are warehouses and plants for cleaning, sorting, processing, and packaging or bagging farm produce. These industries are within fairly close proximity of farms in the survey area, and they have sources for marketing farm produce. These and other small industries provide winter employment and some year-round employment. Many small-farm operators supplement their income in this way.

Interstate Highway 80 crosses the southern part of the survey area, and two State highways provide fairly good access to the towns in the Minidoka Area. The main line of a railroad crosses the northern part of the survey area; a branch of that railroad extends south to the Snake River.

## Climate<sup>6</sup>

The Minidoka Area is in the east-central part of the valley of the Snake River in southern Idaho but to the north of the river. It is comparatively level but slopes gently upward from an elevation of about 4,000 feet near the river to an elevation of nearly 5,000 feet in the northernmost part.

<sup>5</sup> UNITED STATES DEPARTMENT OF AGRICULTURE. SOIL TAXONOMY OF NATIONAL COOPERATIVE SOIL SURVEY, SELECTED CHAPTER FROM SOIL SURVEY. Soil Conserv. Serv. 1971.

<sup>6</sup> By F. C. GIFT, acting climatologist for Idaho, National Weather Service, U.S. Department of Commerce.

The climate of the survey area can be described as midlatitude, semiarid, and on the boundary between steeper or semiarid and desert or arid. Such a climate has warm, dry summers and relatively low annual precipitation. Natural vegetation is sparse, but irrigation has transformed the Minidoka Area into highly productive land where most of the acreage is classified as farmland.

Table 7 shows temperature and precipitation data for the Minidoka Area, and table 8 gives probabilities of low temperatures in spring and fall.

As shown in table 7, precipitation is light and quite variable. Normally, the heaviest precipitation occurs during winter, and the second heaviest occurs in spring. The least precipitation occurs during the hot summer, when the extreme variability makes irrigation a necessity. The latest average date in spring when the depth of snow is 1 inch is March 19, and the earliest in fall is November 21.

Because of the average elevation, temperatures are more characteristic of steppes than deserts. Occasional invasions of Arctic air southeastward across the Continental Divide from Montana cause cold waves in winter. A minimum temperature of  $-41^{\circ}$  F. was recorded January 22, 1962. Such cold spells normally last 3 to 4 days and are rare. The greatest number of days when minimum temperatures were below zero was recorded during February 1964, but the average is only 3 days in January, which is normally the coldest month.

The summers are normally warm and have maximum temperatures of  $90^{\circ}$  or higher for an average of 17 days during July, the warmest month. In July 1953 there were 26 days when the temperature was  $90^{\circ}$  or higher. On July 19, 1960, the highest temperature of  $104^{\circ}$  was recorded. Because of the low relative humidity and the clear skies, minimum temperatures during summer usually cool to comfortable nighttime levels.

Sunshine records are not available. However, records from the Pocatello Weather Bureau Office, which are representative of the survey area, show the following normal percentages for sunshine each month: January, 37 percent; February, 48 percent; March, 59 percent; April, 66 percent; May, 65 percent; June, 73 percent; July, 84 percent; August, 81 percent; September, 79 percent; October, 71 percent; November, 52 percent; and December, 39 percent. Annually the sun shines 65 percent of the time.

There are few wind records for the survey area. Old records for Rupert show a prevailing westerly wind for the entire year, but records of wind velocity are not available. Comparative records at Pocatello, where the prevailing wind direction is southwesterly, show an average hourly speed of 11 miles per hour, and apparently, sustained daytime breezes are common. Damaging winds are uncommon. The highest 1-minute speed recorded at Pocatello was 72 miles per hour in March 1955.

The relative humidity is typical of a semiarid climate. It averages nearly 70 percent on a normal winter afternoon and nearly 20 percent on a normal summer afternoon.

Hailstorms are not frequent and are localized, and damaging hail is rare.

Freezing temperatures are of greater importance to farming in this survey area and, as indicated in table 8, are quite variable. The average growing season, defined as the interval between the date of the last freezing temperature in spring (normally May 14) and the first freezing temperature in fall (normally September 25), is 135 days. However, the growing season ranges from an average of 150 days in areas immediately adjacent to the Snake River to 120 days in the northern part of the survey area.

TABLE 7.—*Temperature and precipitation data*

[Data based on records kept at Rupert, elevation 4, 204 feet, and Paul, elevation 4, 210 feet, for the period 1936 to 1965 and at Minidoka Dam, elevation 4, 280 feet, for the period 1947 to 1965]

Month	Temperature				Precipitation			
	Average daily—		Average monthly—		Average total	One year in 10 will have—		Average snowfall
	Maximum	Minimum	Maximum	Minimum		Less than—	More than—	
	$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.	Inches	Inches	Inches	Inches
January.....	34	15	51	-7	1.0	0.5	1.8	8
February.....	40	20	55	0	.8	.4	1.3	4
March.....	49	26	66	12	.8	.3	1.3	3
April.....	60	33	78	21	.8	.2	1.7	1
May.....	70	41	85	30	1.1	.3	1.9	(1)
June.....	78	47	93	36	.9	.1	1.9	-----
July.....	88	55	99	43	.3	(1)	.6	-----
August.....	86	52	97	42	.3	(1)	.8	-----
September.....	77	43	92	31	.5	(1)	1.0	-----
October.....	64	35	82	23	.7	.1	1.2	-----
November.....	48	25	64	11	.8	.2	1.5	1
December.....	39	20	53	3	1.0	.4	1.5	1
Year.....	61	34	-----	-----	9.0	2.5	16.5	18

<sup>1</sup> Less than 0.05 inch.

TABLE 8.—*Probabilities of low temperatures in spring and in fall*

[Based on data from Rupert, Paul, and Minidoka Dam]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than-----	April 1	April 15	May 3	May 17	June 2
2 years in 10 later than-----	March 23	April 7	April 22	May 8	May 23
5 years in 10 later than-----	March 8	March 25	April 13	April 27	May 14
Fall:					
1 year in 10 earlier than-----	October 26	October 17	October 3	September 20	September 6
2 years in 10 earlier than-----	November 1	October 23	October 10	September 27	September 13
5 years in 10 earlier than-----	November 15	November 6	October 22	October 9	September 25

## Water Supply

The irrigation water for the basalt uplands in the northern part of the Minidoka Area is supplied chiefly from deep wells. Approximately 142,640 acres is irrigated from wells. In most of this area, the wells are owned and managed by the A&B Irrigation District, and one or two wells may serve all or parts of several farms.

Many deep wells are privately owned and serve one or two farms or part of farms. The quality of water from these deep wells is generally good (3).

Water for irrigation on the low terrace in the southern part of the survey area is supplied chiefly from Lake Walcott, which was created by the Minidoka Dam on the Snake River. This water is controlled and managed by the Minidoka Irrigation District. The Minidoka project, which includes Minidoka Dam, was one of the first irrigation projects along the Snake River and is commonly known as the old project. The dam was completed and the first water delivered to farms in 1906. Water for this project is stored in Jackson Lake, American Falls Reservoir, and Palisades Reservoir, as well as in Lake Walcott. The quality of the stored water is good (5), but that of the return flow and the water recovered by pumping from drainage ditches, or about 45,000 acre-feet of water, is questionable. About 70,000 acres in the Minidoka Area is irrigated with water from Lake Walcott and return-flow pumping.

Water delivered into the canal systems averages 5 acre-feet, but because the conveyance loss is about 35 percent, only 3.25 acre-feet is delivered to the farm annually. As much as 7 acre-feet is diverted to some parts of the low terrace. The figures for acre-feet do not include other water that has been diverted but not stored.

## Drainage

The drainage of about 33,000 acres, principally in the southeastern part of the low terrace in the southern part of the survey area, is affected to some degree by a fluctuating water table in summer. In addition, about 2,000 to 2,500 acres is affected by excess soluble salts that are toxic to crops to some degree (fig. 13).

Open drainage ditches installed during the period 1909 to 1915 have improved the drainage somewhat, but not sufficiently. Each year the open drains carry an estimated 50,000 acre-feet of water back to the Snake River, and about 45,000 acre-feet is pumped from them into the canal system. The perched water table that causes the restricted drainage rises and falls relatively fast, depending on the intensity of irrigation in and adjacent to the affected area.

Two theories have been advanced to explain the reason for the impeded drainage. One of these is that restrictive layers stop the downward movement of water before it reaches the main water table at a depth between 65 and 120 feet. The second theory is that any lateral movement of water toward the river to the south and southwest is slowed by deposits of fine-textured soil material.

Studies by the Bureau of Reclamation and the Soil Conservation Service indicate that the water table rises at about the same time in all parts of the affected area. Tentative studies indicate that the irrigation efficiency in adjacent areas not affected by the water table is only about 15 to 20 percent, because the rates of application are high and losses through deep percolation are excessive. Also, an increase in the content of soluble salts in the soils is caused by the high water table. For these reasons, a change in the kinds of crops grown is taking place in this part of the survey area.

## Farming

Farming in the Minidoka Area is mainly the growing of row crops, small grains, and hay, but livestock is also raised. The principal irrigated crops are alfalfa hay, beans, corn for silage, pasture, peas, potatoes, small grains, and sugar beets. Most of the peas and potatoes are grown in the northern and western parts of the survey area. The livestock consists mostly of beef cattle, dairy cattle, and sheep.

Gravity methods of irrigation are used on most farms, but the sprinkler method is used on some relatively large farms in the northern part of the survey area.

In the extreme northern and eastern parts of the survey area is range used for grazing. The vegetation is mostly sagebrush, cheatgrass, and annual weeds, which

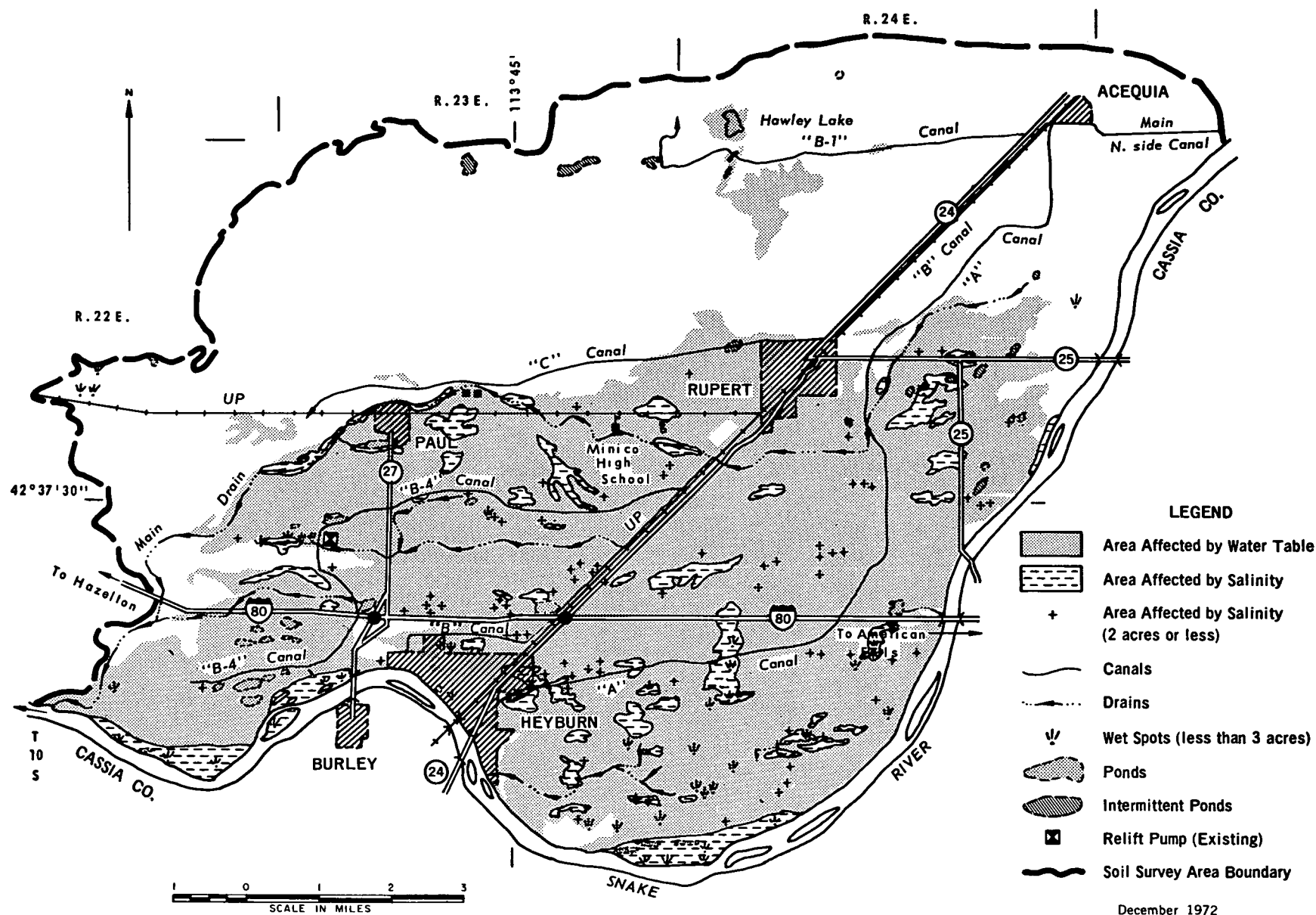


Figure 13.—Areas affected by a high water table and salinity.

are well suited for spring grazing. Most of the grazing land is in the public domain, but scattered small areas are privately owned.

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## Glossary

**Alkali soil.** Generally, a highly alkaline soil. Specifically, an alkali soil has so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases) that the growth of most crop plants is poor from this cause.

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. The ratings used in this survey are as follows: *slightly calcareous*—1 to 3 percent calcium carbonate equivalent; *moderately calcareous*—3 to 15 percent; *strongly calcareous*—15 to 30 percent; *very strongly calcareous*—more than 30 percent.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

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

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

*Cemented.*—Hard and brittle; little affected by moistening.

**Drainage class (natural).** Drainage that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

*Somewhat excessively drained* soils are also very permeable and are free from mottling throughout their profile.

*Well-drained* soils are nearly free from mottling and are commonly of intermediate texture.

*Moderately well drained* soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A horizon and upper part of the B horizons and have mottling in the lower part of the B horizon and in the C horizon.

*Somewhat poorly drained* soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

*Poorly drained* soils are wet for long periods; they are light gray and generally mottled from the surface downward, but some have few or no mottles.

*Very poorly drained* soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

**Depth, soil.** Effective depth to which plant roots can readily penetrate and not be impeded by bedrock or a hardpan. The depth classes used in this survey are as follows:

Shallow.....	6 to 20 inches
Moderately deep.....	20 to 40 inches
Deep.....	40 to 60 inches
Very deep.....	more than 60 inches

**Green manure crop.** A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

**Hardpan.** A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

*O horizon.*—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

*A horizon.*—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

*C horizon.*—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like

that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

**R layer.**—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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

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

**Basin.**—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

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

**Corrugation.**—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards to confine the flow of water to one direction.

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

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

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

**Wild flooding.**—Irrigation water, released at high points, flows onto the field without controlled distribution.

**Leaching.** The removal of soluble materials from soils or other material by percolating water.

**Mottling, soil.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common, and many*; size—*fine, medium, and coarse*; and contrast—*faint, distinct, and prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

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

**Nutrient, plant.** Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil and carbon, hydrogen, and oxygen obtained largely from the air and water, are plant nutrients.

**Ped.** An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

**Permeability.** The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid*.

**Poorly graded.** A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

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

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

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

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

**Saline soil.** A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

**Saline-alkali soil.** A soil that contains a harmful concentration of salts and exchangeable sodium. The salts and exchangeable sodium are so distributed in the soil that growth of most crop plants is less than normal.

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

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Slope classes.** The words describing the numerical slope range are as follows:

	Percent
Level and nearly level.....	0-2
Very gently sloping.....	2-4
Gently sloping.....	4-8
Sloping .....	8-12
Strongly sloping.....	12-20
Moderately steep.....	20-30

**Soil.** A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** Technically, the part of the soil below the solum.

**Surface layer.** The A horizon or the soil ordinarily moved in tillage, or its equivalent in uncultivated soil, generally about 5 to 8 inches in thickness.

**Terrace (geological).** An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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

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