U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
IN COOPERATION WITH
UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE
AND AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF MINIDOKA AREA IDAHO

BY

F. O. YOUNGS, IN CHARGE, AND MARK BALDWIN, U. S. DEPARTMENT OF AGRICULTURE, AND A. J. KERN, AND G. R. McDOLE, UNIVERSITY OF IDAHO

[Advance Sheets—Field Operations of the Bureau of Soils, 1923]

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

BUREAU OF CHEMISTRY AND SOILS

C. A. BROWNE, *Acting Chief*
A. G. McCALL, *Chief, Soil Investigations*
WILBERT W. WEIR, *in Charge of Editorial Work*

SOIL SURVEY

CURTIS F. MARBUT, *in Charge*
M. H. LAPHAM, *Inspector, District No. 5*

COOPERATION
UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE
AND AGRICULTURAL EXPERIMENT STATION

E. J. IDDINGS, *Dean and Director*
G. R. McDOLE, *in Charge of Soil Survey*

U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF CHEMISTRY AND SOILS

IN COOPERATION WITH
UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE
AND AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF MINIDOKA AREA IDAHO

BY

F. O. YOUNGS, IN CHARGE, AND MARK BALDWIN, U. S. DEPARTMENT OF AGRICULTURE, AND A. J. KERN, AND G. R. McDOLE, UNIVERSITY OF IDAHO

[Advance Sheets—Field Operations of the Bureau of Soils, 1923]

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]

CONTENTS

ILLUSTRATIONS

SOIL SURVEY OF MINIDOKA AREA, IDAHO

By F. O. YOUNGS, in Charge, and MARK BALDWIN, U. S. Department of Agriculture, and A. J. KERN and G. R. McDOLE, University of Idaho

AREA SURVEYED

The Minidoka area is in the south-central part of Idaho. It includes both sides of Snake River, largely in the southern end of Minidoka County and the north-central part of Cassia County, and includes narrow strips in Jerome and Blaine Counties. The survey covers 551 square miles, or 352,640 acres. The area is irregularly diamond-shaped, with a length from northeast to southwest of nearly 40 miles, and a width from southeast to northwest of about 25 miles.

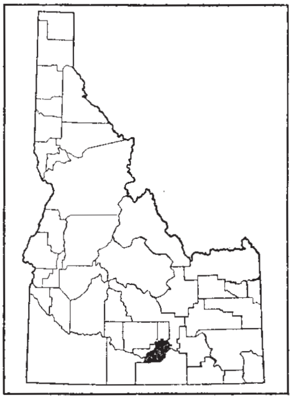


FIG. 1.—Sketch map showing the location of the Minidoka area, Idaho

South of Snake River the western boundary of the area is the Twin Falls County line. The remaining boundaries do not coincide with municipal boundaries, being determined in a general way by the extent of the irrigation projects, completed or planned.

The area includes all of the Minidoka reclamation project and comprises two units, the northside gravity unit covering lands on the north side of Snake River, and the southside pumping unit covering more elevated lands on the south side of the river. In addition it includes a proposed pump extension on the north side known as the Minidoka northside pumping unit, or Minidoka extension.

The area comprises a part of the great Snake River plains and has on the whole a smooth or slightly rolling and hummocky surface, though in the southeastern part it includes a small area of the foothills of Goose Creek Mountains. The central portion of the area, on both sides of Snake River, consists of old stream terraces which are bounded on the west, north, and east by somewhat higher bench lands or uplands, and on the southeast by alluvial fans. On the south the shallow valley of Goose Creek extends southward beyond the boundary of the area.

The boundary between the bench lands and the terraces in many places consists of a distinct escarpment. The surface of the bench lands ranges from gently undulating to rolling and is cut by deep, dry stream channels, or coulees. On the south side of the river and on most of the north side these uplands are gently undulating, with long smooth slopes; but in certain areas on the north side, notably north of Paul, small knobs and depressions, or sinks, occur. A number of rounded hills, or buttes, rise from 100 to several hundred feet above the surrounding country.

The stream terraces north of the river differ from those on the south side, in that most of them are comparatively low and flat, though in places there are knobs and ridges of wind-blown materials, and, along the foot of the bench lands, ridges of basalt. Numerous undrained depressions or sinks are present. The higher terraces on the south side vary from flat to slightly rolling, and for the most part have well-defined drainage channels. Along the southern edge of the area near the foothills, in the vicinity of View, the surface is flat with occasional small depressions. Here the drainage channels are poorly defined. Narrow strips of low, flat bottom lands along Snake River are occasionally inundated. The bottom lands along Goose and Marsh Creeks are very smooth.

The alluvial-fan slopes along the southeastern edge of the area extend into the foothills of Goose Creek Mountains. The lower slopes are comparatively gentle but they grow steeper with height and finally blend with the steep slopes of the hills.

The highest elevation on the north side of the river is 4,395 feet, on the butte northeast of Milner. The larger part of the area lies at an elevation between this and 4,180 feet, the river level just above Milner Dam. The foothills on the southeastern edge of the area rise to more than 5,000 feet. At a drainage sump, in a depression about 5 miles northwest of Rupert, the elevation is 4,184 feet.

The area surveyed is drained by Snake River. Goose Creek, Marsh Creek, and a number of large coulees give ample surface drainage to most of the land south of the river. An exception to this is in the View neighborhood where there are no streams and drainage is effected by an underlying gravel substratum. The bench lands on the north side are mostly well drained by a system of deep-cut coulees, though there are places where undrained basins or sinks occur. These seem to be formed in fissured lava and a few of them have open crevices in the bedrock. In most of them the rock has been covered and the crevices filled, and water may stand for many days after a hard rain. The soils of the terrace lands on the north side of the river have very poor natural surface drainage, and although they are crossed by poorly defined channels from northeast to southwest, no well-defined drainage courses exist and many undrained depressions occur. Under irrigation a high water table has developed over a belt several miles wide north of and parallel to the river, and here artificial drainage ditches have been constructed. The numerous sinks occurring below the escarpment bounding the bench lands catch most of the drainage from the uplands, as well as much local drainage. Artificial drainage has been installed by blasting wells or shafts in the underlying basalt bedrock containing cavities and crevices, but the water can not yet be carried away fast enough to prevent flooding of considerable areas for a time after spring freshets. Much of the sandier terrace lands on the north side, especially those between Rupert and the Minidoka Dam, have excessive subsurface drainage.

Snake River is backed up for many miles by the Milner Dam. The river does not have a swift current, except just below the Minidoka Dam where there is a drop of 40 feet that is utilized for the development of electric power. Prior to the beginning of the construction work on the Minidoka reclamation project by the Bureau of Reclamation, few people lived in the area outside of Minidoka, and these few lived on scattered cattle ranches along Snake River and Goose and Marsh Creeks. The growth of population was rapid for several years following the opening of the Minidoka project in 1905. Since 1920 there has been a decrease in population, owing to a period of depression.

The people are largely native-born Americans, though a fairly large number are of Scandinavian and German parentage. The population includes also a few Japanese and Chinese and a few Mexican laborers. Many of the inhabitants are from Utah and southeastern Idaho, though many have come from the Middle West and other parts of the country.

The population[1] on the Minidoka reclamation project, which comprises probably 95 per cent of the total population of the area, was estimated as 16,471 in 1922. Of this number 8,301 lived on farms and 8,170 in the towns.

Burley, the county seat of Cassia County, has an estimated population of 5,000. It is the largest town in the area and is an important wholesale and retail trading center and shipping point. Rupert, with a population of 2,500, is the county seat of Minidoka County and is the most important town on the Minidoka northside or gravity unit. Paul has a population of about 350; Declo, 150; Heyburn, 135; and Acequia, 35. Minidoka, at the junction of the Twin Falls branch with the main line of the Oregon Short Line Railroad, is at present important only as a railroad town, though it might become an important trading point if the lands under the proposed Minidoka extension were irrigated. Its present population is probably little more than 100.

The area is served by the Oregon Short Line Railroad and a number of its branches. The main line passes through the northeastern end of the area. The Twin Falls branch runs southwest from Minidoka through Acequia, Rupert, Heyburn, Burley, and Milner. At Rupert, the North Side branch of the Oregon Short Line leaves the Twin Falls branch and runs west through Paul. Two short lines extend east and south of Burley.

The country roads in the cultivated areas are nearly all on section or half-section lines. Many miles are graveled and most of the dirt roads are graded.

Rural telephone service covers much of the farming area. Electric light and power are furnished to many farms by the Bureau of Reclamation.

The area has a good system of rural schools, and centralized schools are located in Burley and Rupert.

Marketing is a serious problem in the area. Most of the markets are at a great distance and the freight rates are consequently high. Burley and Rupert are the principal local markets, but they consume only a very small part of the products. The agricultural products are shipped to markets in the Middle West and on the Pacific coast.

CLIMATE

The climate, like that of the rest of the Snake River plains, is characterized by a low annual rainfall, low humidity, hot, dry summers, cold winters, and a high percentage of cloudless days.

In the years since weather records have been kept at Rupert the annual precipitation has ranged from 6.86 inches to 19.62 inches,

[1] The figures quoted are from estimates made by the U. S. Reclamation Service in the 1922 Crop Reports, covering the two units of the Minidoka Project.

averaging 11.86 inches. The rain usually comes largely in the fall, winter, and spring. The summers are usually very dry, though in some years considerable rain occurs. Hay and seed crops can usually be cured in the field with little danger of damage from rain.

The maximum summer temperature recorded at the Rupert station was 104° F. and the minimum winter temperature was −24° F. These extremes are not common. The dry heat of the summer is not oppressive. Many winters are rather open, though considerable snow falls at times. The average date of the last killing frost in the spring is May 15; that of the first in the fall, September 18. The latest recorded frost in the spring occurred on June 6 and the earliest recorded in the fall on August 25. The average length of the frost-free season is 126 days.

Strong winds are common, especially in the spring and early summer. Tornadoes are unknown and thunderstorms are of infrequent occurrence.

The growing season is intermediate in length between that farther west in the Snake River Valley and that farther east in the higher parts of the valley. Some of the more tender crops, such as beans and corn, are not grown on a large scale here. Very little fruit is grown on account of danger of loss by spring frost, though good crops are obtained in some years. There are undoubtedly certain favorable slopes and exposures where the hardier fruits could be safely grown in most years.

The following table gives the more important climatic data as recorded at the United States Weather Bureau station at Rupert:

Normal monthly, seasonal, and annual temperature and precipitation at Rupert

[Elevation, 4,204 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1907)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	26.7	70	−19	0.98	0.76	2.61	5.7
January	24.9	60	−24	1.37	1.07	.94	7.6
February	30.0	62	−21	1.06	1.14	2.29	7.2
Winter	27.2	70	−24	3.41	2.97	5.84	20.5
March	38.8	73	−2	.93	.10	5.45	3.5
April	46.3	85	14	1.03	.59	1.84	.6
May	53.9	95	20	1.29	.17	.77	.6
Spring	46.3	95	−2	3.25	.86	8.06	4.7
June	63.2	101	28	.94	.01	2.40	Trace
July	70.8	102	34	.57	.46	.26	0
August	68.0	104	24	.52	0	.62	0
Summer	67.3	104	24	2.03	.47	3.28	Trace
September	58.4	97	17	.77	.78	.96	0
October	48.6	87	11	1.14	.40	.83	1.6
November	37.3	76	−10	1.26	1.38	.65	2.0
Fall	48.1	97	−10	3.17	2.56	2.44	3.6
Year	47.2	104	−24	11.86	6.86	19.62	28.8

AGRICULTURE

Up to the time of the opening of the Minidoka reclamation project, there was very little agricultural development in the area. The whole country was covered by a growth of sagebrush, rabbit brush, and some grass. (Pl. 35, fig. 1.) A few scattered stock ranches were located along Snake River and on Marsh Creek and Goose Creek, and the region was used as winter range by the stockmen. Very little actual farming was done.

Irrigation water was first supplied by the United States Reclamation Service in 1907 to the settlers on the Minidoka gravity unit, or northside unit. Two years later water was furnished on the Minidoka southside pumping unit. Since that time most of the land irrigable under present canals and pumping lifts has been brought under cultivation. The Murtaugh lift project, a private enterprise, was opened only a few years ago, and it supplies water to a few hundred acres of land south and west of Milner.

A number of years ago (1914–1916) many thousands of acres of the bench lands on both sides of the river were taken up for dry farming, and a few crops were grown. Nearly all of these farms have been abandoned. Only in exceptional years and under especially favorable circumstances have profitable crops been grown. Wheat has been the principal crop.

On the irrigated lands no great change has been made in the kinds of crops grown nor in the methods of farming since the projects were opened. Alfalfa, wheat, potatoes, and, since the building of the sugar factories, sugar beets have been and are now the principal crops grown. The acreage of the different crops and their value vary greatly from year to year. Other important products are clover hay and clover seed, oats, barley, and corn. Alfalfa seed and apples return considerable income in some years. Small acreages of other crops are reported, such as common hay, fodder corn, rye, mangels, small fruits, beans, and onions. An area of several thousand acres is devoted to pasture and nearly a thousand more to home gardens.

The total cropped area on the Minidoka project in 1922, according to crop-report data furnished by local offices of the Bureau of Reclamation, was 99,805 acres. Besides this, several hundred acres were under cultivation on the Murtaugh lift project and under private water rights, and a few hundred acres were dry farmed.

In 1922, 39,393 acres were devoted to the production of alfalfa hay [2] on the Minidoka project, making it by far the most important crop in point of acreage in the area. The total estimated production was 113,629 tons. The average yield was 2.88 tons an acre and the acre yields reported range from 1 to 6 tons. Shortage of water at the peak of the irrigation season reduces the yields, especially on those soils having little moisture-retaining power. The larger part of the hay was fed to farm livestock, range cattle, and sheep, and the remainder was shipped to outside markets. The alfalfa weevil infests this district, and weevil-free districts impose a quarantine against alfalfa

[2] The data in this section pertaining to the Minidoka project were obtained in part from crop and other statistics furnished by local offices of the Bureau of Reclamation at Rupert and Burley, and in part from report on Federal Reclamation by Irrigation, Senate Document No. 92, Sixty-eighth Congress, first session, 1924.

shipments. The weevil seriously affects only the first of the three annual cuttings of alfalfa.

Alfalfa is commonly cut three times each season. It is cured and stacked in the field, with comparatively little danger of damage by rain. This crop is important in this region, as it not only aids in maintaining the organic matter in the soils but helps to prevent the blowing of the sand and sandy soils.

In 1922 potatoes were grown on 15,640 acres of the Minidoka project, with a total production of 3,581,405 bushels, or an average yield of 229 bushels an acre. The yields ranged from 25 to 500 bushels an acre. The potatoes grown here are large, smooth, and of very good quality. The two standard varieties are Idaho Rural and Netted Gem or Russet Burbank. They are much in demand in California and the Middle West.

The potatoes (Pl. 35, fig. 2) are dug by machinery, sorted and sacked in the field, and generally shipped in refrigerator cars. Comparatively little provision for storage is made, most of the crop being marketed at the time of digging.

The wheat acreage on the Minidoka project in 1922 was 19,270 acres. The yields reported ranged as high as 75 bushels an acre, the average yield being 28.9 bushels.

A small acreage is devoted to dry-farmed wheat, and the average production is probably between 8 and 10 bushels an acre. Failures are not uncommon, and occasional yields as high as 20 bushels are reported. A considerable part of the wheat grown is ground into flour at Burley, but a large quantity is shipped to the markets of the Middle West and the Pacific coast. Most of the wheat is spring sown, and is largely of the soft white varieties. (Pl. 36, fig. 1.)

The total area in sugar beets in 1922 was 5,265 acres. The average acre yield was 11.84 tons, with some yields as high as 32 tons. The sugar beets grown here are made into sugar at the factories at Paul, Burley, and Twin Falls. The beet tops and beet pulp are used locally as feed for sheep and cattle. Sugar beets require careful cultivation and irrigation and much handwork. Mexican laborers are hired extensively for work in the beet fields.

According to the 1922 estimates made by the United States Reclamation Service there were on the project 7,353 horses, 177 mules, 7,223 dairy cattle, 863 beef cattle, 7,648 sheep, 12,218 hogs, 110,332 fowls, and 1,422 hives of bees. In addition to these a large number of range sheep and a smaller number of range cattle are fed on the irrigated farms during the winter. Dairying is not carried on very extensively, many farms having few or no dairy animals. Although some milk is consumed locally and a little butter, cheese, and ice cream are made in the area, considerable cream is shipped to Pocatello, Salt Lake, and Butte for manufacture into butter.

Practically all the common crops of the region are grown with fair success on all the important soils of the area where sufficient water is supplied. The lighter soils are generally recognized as best adapted to alfalfa, potatoes, and beets, and the heavier ones, especially those of the Paul series, as being especially adapted to small grains. The soils of the Goose Creek, Portneuf, Declo, and View series are generally recognized as being well adapted to all the common crops.

Irrigation is ordinarily necessary for the continued profitable production of practically all the crops of the area; nevertheless, some dry-land grain farming is done.

On some of the farms grains, sugar beets, and alfalfa have been grown in succession on the same land for many years. Many farmers practice a rotation of alfalfa, grain, and beets or potatoes. Practically no commercial fertilizers are used. Stable manure is used to some extent, but much of it is wasted and many straw stacks are burned. The farmers rely mostly on the growing of alfalfa and clover to furnish the needed organic matter.

Many of the farmers hire little or no outside help, depending on themselves and their families to do the farm work. For haying, harvesting, and threshing, labor is customarily exchanged among the farmers. Hired help is paid $40 or more a month. Special harvest labor receives from $3 to $6 a day.

The farms range in size from a few acres to 160 or more acres. There are comparatively few of the smaller farms, and most of these are close to the towns. The average size of the holdings is about 50 acres, with an average cropped area of approximately 42 acres. Of the 2,451 farms on the Minidoka project, 76.2 per cent are operated by owners and 23.8 per cent by tenants. The rent is sometimes on a cash basis but more often on shares. In share renting, the landlord receives from one-third to three-fifths of the crop, depending on the number of head of livestock, quantity of seed, the number of implements furnished by him, and on the nature of the crop grown. The tenant receives a larger share of such crops as beets and potatoes, where the labor and expense of growing the crop is greater than of such crops as grain and hay.

Very little land is changing hands at the present time (1923). Prices have dropped decidedly from the high peak attained just after the war. From $75 to $300 an acre is the estimate made by farmers as the value of their lands, depending on the quality of the soil, improvements, and nearness to the towns and railroads. Probably a normal price range would be from $125 to $150 an acre.

SOILS

The soils of the greater part of the Minidoka area are remarkably uniform, in that they are nearly all comparatively low in organic matter and high in the mineral elements. Brown, varying in shade from light grayish brown to a decided brown, is the prevailing color of the surface soils over the whole area, with the exception of some of the bottom-land soils, which are dark grayish brown or black because of the accumulation of organic matter. Most of them have a surface soil which is only very slightly calcareous and a subsoil which is highly calcareous.

The mature soils may be regarded as those which have developed well-defined characteristics. These characteristics are well defined because the soil-forming forces of the region were not limited or retarded in their action. Mature soils cover approximately 90 per cent of the area surveyed and include the members of the Portneuf, Minidoka, Winchester, Declo, Paul, Ephrata, and View series. The profile typical of the mature soils may be described from the surface downward as follows: (1) A surface layer from one-half to 3 inches thick having a soft, slightly coherent crust. The material is porous, vesicular, and very loose. The mass breaks with very slight pressure of the finger and falls into a dry, powdery to slightly granular mass. The color is very light brown, considerably lighter than the layer immediately below it. This surface layer is well developed only in the finer-textured soils, and then only in locations free from vegetation. This layer is seldom calcareous. (2) A moderately compact layer of somewhat flocculated or granulated material, slightly heavier in texture than the surface layer and distinctly more compact. The upper part of this layer is somewhat darker than the surface layer, and the color becomes lighter with depth. The upper part is calcareous in some of the soils, and the deeper portion usually gives a reaction for carbonate of lime. This layer extends to depths ranging from 6 to 20 inches and has an average depth of about 11 inches. (3) A layer of high lime concentration averaging about 2 feet in thickness. The color may be light-grayish brown, light-yellowish brown, or cream colored. The upper part of this layer is not especially compact, but the lower part is decidedly so. (4) A less compact layer, decidedly calcareous but less so than the overlying material. This profile is most typically developed in Portneuf silt loam.

Soil having a brown or dark-brown subsurface layer distinctly heavier in texture than the surface soil occurs in some locations, in flat areas where it seems probable that the clay has been carried down from the surface layer. This condition occurs in the members of the Paul and View series. In the Minidoka and View soils the compact lime layer, No. 3, is replaced by a lime-cemented hardpan, or caliche. In the Minidoka soils, and to less extent in the Declo soils, the deeper subsoil, layer No. 4, is compact and somewhat cemented, although much softer than the overlying layer No. 3.

The Rupert, Onyx, Goose Creek, and Snake soils may be considered young soils. It is doubtful whether the Rupert soils are much younger, as reckoned from the time of deposition, than some of the soils classed as mature. However, owing to the conditions under which these soils have developed, the subsoils are without definite zones of lime accumulation and give no effervescence with acid within 6 feet of the surface. This may be due to the very loose and porous soil material and the consequent excessive underdrainage. A concentration of clay particles generally occurs at a depth of 2 feet, forming a somewhat heavier and more compact layer. Much the same condition exists in the basin phase of Portneuf silty clay loam, which occurs in undrained depressions where water stands for some time after a rain. Little lime is present within a depth of 6 feet, but there is a concentration of clay in the upper part of the subsoil. In the Onyx soils, on the other hand, the subsoils are highly calcareous and the typical profile resembles that of the more mature soils, although they are associated with the recent-alluvial soils and the material is still in process of accumulation. The Goose Creek soils which occur on the flat bottom lands of Goose and Marsh Creeks are also low in lime to a depth of 6 feet, but the subsoils, in places, give a slight or distinct effervescence with hydrochloric acid. There is no discernible modification owing to weathering, though a large accumulation of organic matter, formed by the growth and decay of a rank vegetation, has taken place. Snake clay loam is calcareous in both topsoil and subsoil, and apparently no decided concentration of lime carbonate has taken place in the subsoil. The surface material of this soil also contains much organic matter.

The soils of the Snake River plain represent mixtures of materials originating from a great number of sources, many of the materials having come a great distance. Dark fragments of basalt and white quartz grains are usually very prominent, and mica is very abundant, especially in the finer materials. The sediments brought down by Goose Creek, and materials of the alluvial fans along the foothills of Goose Creek Mountains are more micaceous and yellower than the other soil materials in the area. The basalt substratum is but slightly weathered and appears to have contributed little to the soils of the area. The sedimentary and metamorphosed formations in Goose Creek Mountains have contributed materially to the soil materials in the southern part of the area.

The soils of the area range in texture from sand to silty clay, the most extensive soils being silt loams and loams, although sandy loams, fine sandy loams, very fine sandy loams, clay loams, sands, and fine sands also cover considerable areas.

Wind and water are responsible for the accumulation of the soil materials in this area. Wind-blown or wind-borne material is probably present in every soil, forming the entire mass of the most extensive soils, and the process of soil formation by wind transportation is yet going on. In the sandier sections the surface material is constantly shifting, the finer, dustlike material, commonly spoken of as "lava ash," settling after the frequent dust storms. Large quantities of material have been carried to the lower lands by Snake River, as well as by Goose Creek, Marsh Creek, and some of the larger intermittent streams which drain the bench lands. The older and more extensive of these deposits occur on the old river terraces and are classed as old valley-filling material. The newer and less extensive deposits are considered as recent alluvium, and small alluvial-fan deposits are present on the southeastern edge of the area.

The soil-forming materials of the area are classed in four groups: (1) Aeolian or wind-laid material, (2) old valley-filling material mainly of stream-laid accumulation, (3) recent deposits of alluvium, (4) miscellaneous types or classes of material.

In the first group of materials formed of wind-laid deposits, are the members of the Portneuf, Minidoka, and Winchester series. The heavier soils of the first two series are derived from fine dustlike, wind-borne material, much of which has settled from atmospheric suspension and has been transported long distances. The lighter-textured soils, or at least their surface soils, and the Winchester soils, have developed largely from coarser materials which have been rolled along or blown along near the surface for short distances, giving rise to a dunelike or wind-blown surface relief.

The soil material of the members of the Portneuf and Minidoka series is fine textured and floury, and is generally 6 feet or more deep in both series, in places having a thickness of 20 feet or more. Both have noncalcareous surface soils of various shades of brown. The tough compact, light grayish-brown upper subsoil has high lime concentration at depths ranging from 12 to 18 inches. Soils of both series have substrata consisting of uneven beds of lava rock which crops out in a few places. But these soils differ very much in the lower part of their subsoils. In the Portneuf soils a very compact layer of high lime concentration occurs, ranging from a few inches to 1 foot in thickness; and in the Minidoka soils occurs a well-developed layer, about 1 foot thick, which consists of thin, platelike sheets very firmly cemented with lime. In the Minidoka soils there may be two or three such layers separated by comparatively loose material. The subsoil material below the cemented layer is compact and slightly cemented, but soft as compared with the layers immediately above it. Both Portneuf and Minidoka soils occur as bench lands, but the Minidoka soils are somewhat higher and farther from the river. The areas are slightly rolling and the drainage is well developed.

Winchester soils have surface soils of loose, shifting, sandy material practically free from lime. The color, usually light brown, has in many places a distinct dark-gray tinge because of the high percentage of black basaltic particles. The material has been blown along the surface from near-by sandy, water-laid deposits. These soils occur in rather small bodies which usually form long, narrow, dunelike ridges, though some areas have a fairly smooth surface. Underdrainage is usually excessive.

The surface layers of Rupert soils are coarser in texture than those of other soils of this area and are underlain by a heavier subsoil several inches in thickness. They are noncalcareous throughout, but everywhere in the soil mass a small quantity of gravel is present.

In the Ephrata soils the soil is loose, leachy, and has little power to hold moisture. It is of uniform texture throughout and is slightly finer than that of the Rupert soils. At a depth of 30 inches there occurs a zone of lime concentration.

View soils have a friable topsoil to a depth of 10 inches and a slightly heavier, compact subsurface layer to a depth of 18 inches where a soft lime cemented hardpan occurs. Between this and the gravel substratum there is usually a layer of finer-textured material from a few inches to several feet in thickness.

The recent-alluvial soils include those of the Onyx, Snake, and Goose Creek series. The brown Onyx soils consist largely of outwash materials from the higher areas of Portneuf and Minidoka soils. Snake and Goose Creek soils are dark gray or nearly black and are derived from recent stream deposits.

The Onyx soils in this survey consist largely of loessial materials which have been blown and washed into coulee bottoms from areas of Portneuf soils. These soils occur as elongated, narrow, flat areas along the coulees and on the alluvial fans at the mouth of the coulees where they extend onto the old stream terraces. The topsoils are moderately supplied with organic matter and are noncalcareous. The subsoils are of lighter color, highly calcareous, usually rather compact, and without shallow gravel substrata.

In the Snake soils the topsoils are usually rich in organic matter. The subsoils are light gray. Lime is abundant throughout the soil but its concentration in the subsoil seems comparatively slight. Snake soils occur as narrow, low, flat strips along the river and have poor drainage. They are swampy in many places and usually have a rather high surface concentration of alkali salts.

Like the soils of the Snake series, the Goose Creek soils contain much organic matter. The subsoils consist of irregularly stratified materials of different textures and are predominantly brownish gray. Lime is usually not present in sufficient quantities to produce effervescence with hydrochloric acid. These soils, which consist of a large variety of rock materials, occur along creeks. The areas are flat or gently sloping and the surface drainage is fair. Underdrainage is usually good and alkali accumulations are rare.

The fourth group includes the miscellaneous types of nonagricultural materials, which include rough mountainous land, rough broken and stony land, and scabland.

Soils representing 11 soil series were mapped in the Minidoka area, including 20 types of soil and 15 subordinate phases. Besides these, three classes of miscellaneous material are shown on the map. In the following pages of this report the soils are described in detail, and their agricultural uses and possibilities are brought out. Their location and distribution are shown on the accompanying soil map, and the following table gives the name and the proportionate extent of the soils mapped in the area:

The types of soil mapped in Minidoka area

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Portneuf silt loam	106,816	37.6	Declo fine sandy loam	8,704	3.6
Stratified-substratum phase	8,320		Light-textured phase	3,776	
Shallow phase	13,632		View fine sandy loam	14,592	4.5
Sloping phase	3,584		Light-textured phase	1,344	
Portneuf very fine sandy loam	1,600	1.0	Goose Creek clay loam	7,808	2.2
Stratified-substratum phase	1,856		Goose Creek silty clay	1,792	.5
Portneuf fine sandy loam	1,920	4.3	Ephrata fine sandy loam	3,456	1.0
Stratified-substratum phase	6,976		Ephrata fine sand	3,776	1.1
Alluvial-fan phase	6,336		Onyx silt loam	9,216	2.6
Portneuf silty clay loam, basin phase	3,520	1.0	Minidoka very fine sandy loam	31,680	9.0
Paul loam	16,960	4.8	Minidoka fine sandy loam, alluvial-fan phase	4,608	1.3
Paul fine sandy loam	6,464	2.7	Minidoka fine sand	4,032	3.6
Shallow phase	3,136		Loamy phase	8,448	
Paul clay loam	3,904	1.1	Winchester fine sand	6,720	1.9
Paul fine sand	9,664	3.3	Snake clay loam	3,328	.9
Shallow phase	1,856		Scabland	9,536	2.7
Rupert sandy loam	13,440	4.3	Rough broken and stony land	4,244	1.2
Light-textured phase	1,920		Rough mountainous land	2,944	.8
Rupert sand	7,488	3.0			
Bedrock phase	3,264		Total	352,640	

PORTNEUF SILT LOAM

The surface soil of Portneuf silt loam, to an average depth of 1½ inches, is light-brown silt loam, forming a very soft and easily crushed platelike crust which is filled with small, round cavities or vesicles. This layer absorbs water almost instantaneously. Beneath it is a slightly darker and slightly more compact layer of somewhat flocculated silt loam, ranging from 4 inches to 1 foot or more in thickness. This is underlain by lighter-brown material a few inches thick, which, though distinctly calcareous, is not especially compact. At a depth of 15 inches, this layer grades into very compact light grayish-brown or cream-colored, very calcareous nodular material which continues to a depth of 30 or 40 inches. The unmodified parent soil material below is loose and floury though it contains small, slightly cemented calcareous granules. The deeper substratum, composed of basalt bedrock, is capped by a layer of lime-cemented hardpan which varies in thickness from a few inches to 1 foot or more. The bedrock rarely comes within 6 feet of the surface, and in many places it is probably 20 or more feet below the surface, though, owing to the unevenness of the lava bed, the depth varies greatly in short distances. In areas where the bedrock or the hardpan overlying it comes within 3 feet of the surface, if of sufficient extent, the soils have been differentiated on the soil map and described as a shallow phase of Portneuf silt loam.

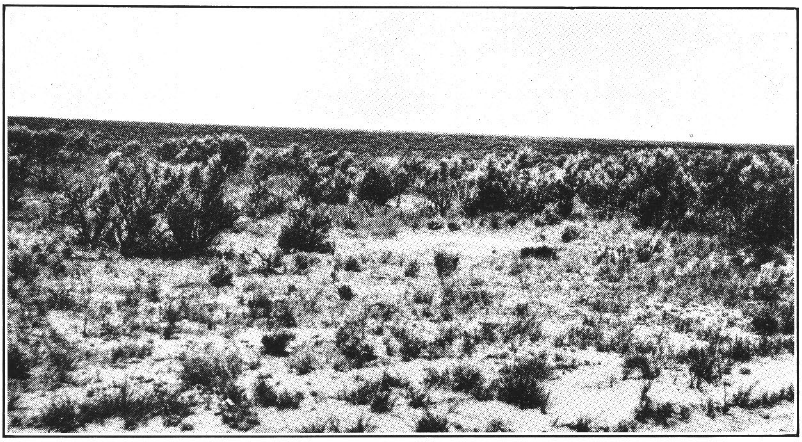
Under cultivation, the first two layers are mixed, so that the resulting color of the soil is brown, appearing dark brown when moist. In many places badgers have brought up the calcareous subsoil material and mixed it with the surface soil. Where this soil is adjacent to Minidoka very fine sandy loam, the deep subsoil or substratum in many places is the same as that of the latter soil, though it is generally 3 or more feet below the surface. There are some small patches of very fine sandy loam, and others in which the surface is covered, to a depth of several inches, by loose and granulated material which has blown from exposed areas, usually from land which has been cleared for cultivation.

Portneuf silt loam is the most extensive soil surveyed, extending over about one-third of the area. It occurs mainly on the benches or uplands surrounding the river terraces on the north side of Snake River and on those southwest of Burley on the south side of the river.

The surface of this land varies from nearly flat to decidedly rolling. In places intermittent streams have cut deep and steep-sided coulees into the loessial deposits, and north of Paul numerous small depressions occur. For the most part, the surface is well adapted to efficient irrigation, though on some of the rougher and steeper portions care will have to be exercised to prevent erosion and loss of water. This soil can hold great quantities of moisture. The surface drainage is good except in the region of sinks or undrained depressions. The underdrainage is apparently good, owing to the deep, permeable subsoil and the somewhat porous and creviced lava substratum. Alkali accumulations are not in evidence at the present time, although they may form if a high water table is developed.

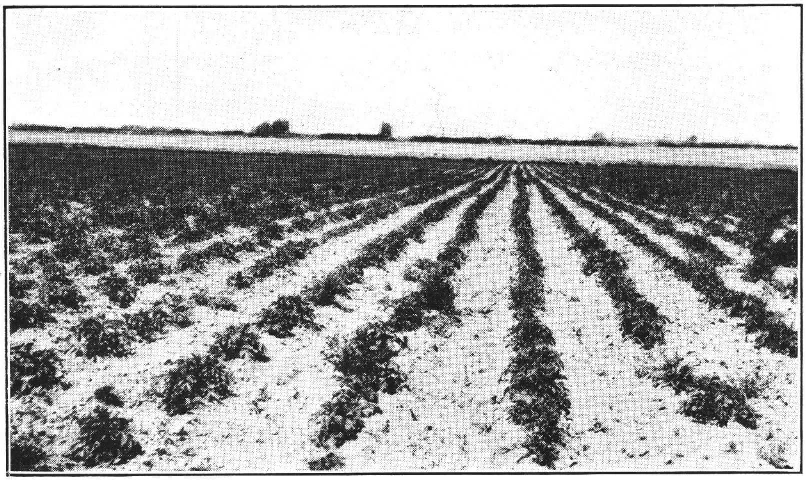
In the virgin state, this soil is covered by a vigorous growth of sagebrush (Pl. 36, fig. 2), and some rabbit brush, and western wheatgrass and fine-leaved bluegrass are plentiful in some places. When cleared and left idle, a thick growth of wild mustard or of Russian thistle quickly springs up. Clearing the land of sagebrush generally costs from $5 to $10 an acre.

This soil is still largely in the virgin state. Approximately 4 square miles are under irrigation. About the same area was cleared for dry farming, but has been abandoned. Alfalfa hay yields from 2 to 5 tons an acre, with an average of about 3 tons; sugar beets yield from 10 to 15 tons; oats, from 40 to 60 bushels; wheat, from 20 to 50 bushels; and potatoes, from 100 to 300 bushels. On the dry-farmed lands wheat yields have ranged up to 20 bushels an acre, the average



NO. 11539

FIG. 1.—CHARACTERISTIC SAGEBRUSH VEGETATION AND SURFACE FEATURES OF PORTNEUF VERY FINE SANDY LOAM

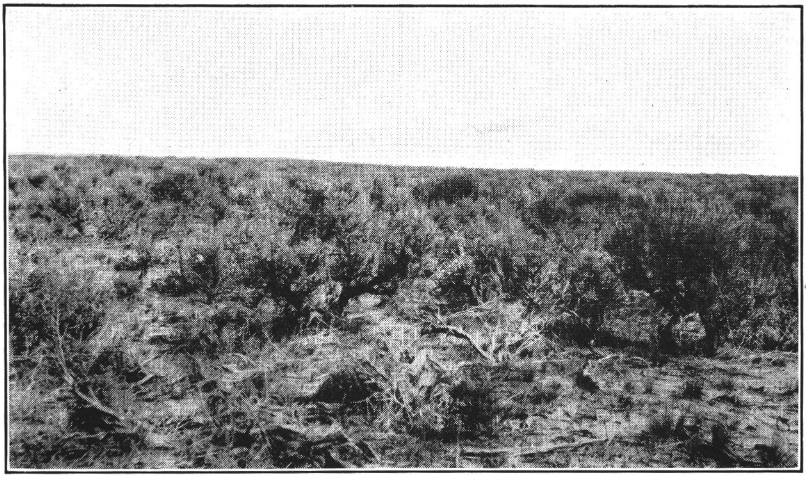


NO. 11537

FIG. 2.—POTATOES ON RUPERT SANDY LOAM

NO. 12030

FIG. 1.—GRAIN STUBBLE ON PORTNEUF SILTY CLAY LOAM, BASIN PHASE



NO. 12037

FIG. 2.—HEAVY GROWTH OF SAGEBRUSH ON AN AREA OF TYPICAL PORTNEUF SILT LOAM

being between 8 and 10 bushels. A large area of this land may be brought under irrigation in the proposed Minidoka northside pumping unit or Minidoka extension, and in the Hansen-Butte project. Land values range from $125 to $200 an acre for irrigated land and from $10 to $30 an acre for dry-farm land.

The chief needs of this land are careful leveling for irrigation, crop rotation, and the plowing under of straw and manures. This soil is very extensive in the Twin Falls area,[3] and there, as a rule, gives somewhat higher yields than in the Minidoka area.

Portneuf silt loam, stratified-substratum phase.—The soil of this phase differs from that of typical Portneuf silt loam in that the underlying substratum of hardpan and bedrock of the latter is replaced by loose, porous, water-laid materials ranging from fine sand to gravelly sand, which are present in only a few places within 6 feet of the surface. Occurring in narrow strips along the boundaries between this soil and the water-laid soils of the river terraces, it consists of a mantle of Portneuf silt loam over water-laid material. In patches the surface soil is fine sandy loam, very fine sandy loam, and loam.

The total extent is nearly 13 square miles. The largest body occurs west of the Goose Creek bottom lands southwest of Burley.

The larger bodies are fairly level or slightly rolling, but the smaller bodies usually form ridges which rise above the terrace lands. The surface is generally favorable for irrigation, except on some of the narrower ridges and steeper slopes. The water-holding capacity of the soil is high. Drainage is good and alkali accumulations are present only in small areas on both sides of Snake River west of Starrhs Ferry.

This ranks as an important agricultural soil. Probably between 80 and 90 per cent of it is under cultivation. Most of the remainder has not been supplied with irrigation water because of its position above the present ditches, but it is probable that a portion of this may yet be irrigated. This soil which comprises the bottom lands on the north side of Snake River between Starrhs Ferry and Milner may be irrigated under the Minidoka north side pumping unit. This soil produces good yields of all crops common to the area, and the yields are more uniform than on most of the other soils. Alfalfa yields from 2 to 4 tons to the acre, with an average of about 3 tons; sugar beets from 10 to 18 tons, with an average of 12 tons; potatoes from 100 to 300 bushels; oats from 40 to 60 bushels; and wheat from 20 to 50 bushels. Small acreages of barley, clover, corn fodder, and onions are grown, and several small apple orchards have produced good crops in favorable years. Current values of cultivated land of this phase are estimated at from $125 to $200 an acre, depending on position, improvements, and nearness to towns.

Portneuf silt loam, shallow phase.—The shallow phase of Portneuf silt loam has a surface layer, from 1 to 3 inches thick, of friable, very light brown silt loam or very fine sandy loam, underlain to a depth ranging from 6 to 10 inches by a layer that is somewhat heavier,

[3] SOIL SURVEY OF THE TWIN FALLS AREA, IDAHO. U. S. Dept. Agr., Field Operations, Bur. Soils, 1921.

more compact, and of decided brown color. This layer grades downward into lighter-colored, distinctly calcareous material. At depths ranging from 12 to 18 inches a very light grayish-brown or cream-colored compact layer occurs, underlain within a depth of 3 feet by a lime-cemented hardpan. This hardpan is immediately underlain by the basalt bedrock, and small basalt and hardpan fragments are scattered through the soil. In many places the hardpan is somewhat fragmentary, and loose basalt bowlders are present. Small patches are decidedly stony.

This soil is widely distributed in the area but occurs in rather small bodies, and its total extent is 21.3 square miles. It is associated with typical Portneuf silt loam and Minidoka very fine sandy loam on the upland benches, commonly occurring on the brows of knobs and on slopes facing westward or southwestward where the west wind has prevented the accumulation of a deep layer of soil material.

Areas vary from nearly flat to somewhat rolling or sloping, but are rarely too steep for successful irrigation. The surface drainage is good, but the underdrainage, on account of the nearness to the surface of the bedrock substratum, is impeded. It seems probable that small water-logged areas may develop if the land is irrigated. However, as this soil holds less moisture than do the deeper soils, it will doubtless dry out quickly and require frequent irrigation.

The loose rock present in this soil is a source of considerable trouble in cultivation, so that clearing off the stones is essential in many places to the preparation of the land for cropping.

At the present time this soil is not important agriculturally. The total area under cultivation is probably less than 200 acres. The principal crops are alfalfa, small grains, potatoes, and sugar beets. The yields probably run slightly lower than on the typical soil. The same cultural methods are applicable, except that more frequent irrigation may be required. Much of the soil may be irrigated in the Minidoka northside pumping unit.

Portneuf silt loam, sloping phase.—The sloping phase of Portneuf silt loam includes those areas of Portneuf silt loam which are too steep or too rough to farm by the methods in use here. The soil material is usually deep and free from stones. The brown surface layer has been eroded in some places, leaving the whitish subsoil exposed, particularly on the south slopes. In other places, notably on north slopes, the layer of brown material is deeper than that in the typical soil.

Soil of this phase marks the narrow escarpments which bound the bench lands or the different levels of the benches, and it occurs on the steep slopes of the deep coulees and on the steeper slopes of several of the buttes in the area. Surface run-off is very rapid.

None of this soil is under irrigation, but much of it is included in the proposed Minidoka northside pumping unit and a small acreage may be included in the Hansen-Butte project.

The following table gives the results of mechanical analyses of samples of the surface soil, subsurface, and three sections of the subsoil of typical Portneuf silt loam.

Mechanical analysis of Portneuf silt loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541010	Surface soil, 0 to 1 inch	0.0	0.0	0.1	0.8	30.1	58.6	10.3
541011	Subsurface, 1 to 7 inches	.1	.1	.1	.7	33.5	52.8	12.8
541012	Subsoil, 7 to 12 inches	.2	.1	.0	.4	27.2	52.7	19.3
541013	Subsoil, 12 to 42 inches	.0	.0	.0	.8	37.7	50.1	11.5
541014	Subsoil, 42 to 72 inches	.0	.0	.0	1.4	62.0	32.3	4.7

PORTNEUF VERY FINE SANDY LOAM

Portneuf very fine sandy loam has a surface layer, from one-half inch to 2 inches thick, of very light brown, very fine sandy loam which is held together in the form of a soft, easily crumbled porous or vesicular crust. The brown layer below is slightly flocculated very sandy loam somewhat columnar in structure, and continuous to depths ranging from 5 to 18 inches. The next layer, but a few inches thick, is light brown and highly calcareous, though not particularly compact. From an average depth of 18 inches, a light grayish-brown or light-gray very compact layer of high lime accumulation continues to a depth of 30 or 40 inches. Beneath this is the comparatively loose and floury light grayish-brown or light yellowish-brown unmodified parent soil material which varies in texture from very fine sandy loam to silty loam and contains small, soft lime nodules. The deeper substratum, which rarely occurs within 6 feet of the surface, consists of lava rock capped by a thin layer of lime-cemented hardpan. The soil material is largely loessial or wind borne, though a small quantity of the coarser material has, no doubt, been blown from near-by terrace lands. A loose surface covering of very fine sand or very fine sandy loam which is shifted by wind occurs over a considerable area of this soil. On the slopes, the lime layer has been exposed in many places by erosion, and badgers have brought up the calcareous subsoil material and mixed it with the surface material.

Portneuf very fine sandy loam is of small extent, covering slightly more than 2 square miles. It occurs in rather small bodies along the edge of the upland northwest, north, and northeast of Acequia.

The surface varies from fairly level to decidedly rolling. Drainage is good. The water-holding power of this soil is high, and except for the small patches which are very rolling, it is well suited for irrigation.

None of this soil is under cultivation, as it is above the present gravity ditches. However, it may be irrigated under the proposed Minidoka northside pumping unit; if so, it will then have an agricultural value probably equal to that of the soil having the stratified substratum.

Portneuf very fine sandy loam, stratified-substratum phase.—Portneuf very fine sandy loam which has a stratified substratum is practically the same as typical Portneuf very fine sandy loam, except that the substratum consists of stratified, water-laid materials at different depths below 36 inches. The surface has been disturbed by cultivation in most places, so that the consequent mixing of the first two layers has resulted in a color which ranges from light brown to brown. In places the surface soil approaches silt loam. Mapped areas of this soil include patches of fine sandy loam.

This soil occurs entirely on the south side of Snake River, along or near the north edge of the high terrace which comprises the greater part of the Minidoka southside unit. Two rather extensive areas occur southeast of Burley, and one north of Declo. The total extent is nearly 3 square miles. Areas range from rather flat to gently undulating. The drainage is good and harmful alkali accumulations are unknown. The water-holding capacity of this soil is high and the surface is favorable to irrigation. Practically all of it is under cultivation at the present time, and seems to be well adapted to all of the common crops grown in the region. Alfalfa hay yields, as reported from 1922, range from 1½ to 4 tons an acre, with an average of about 3 tons; clover hay, 4 tons; sugar beets, from 15 to 18 tons; corn fodder, 12 tons; potatoes, from 100 to 400 bushels, averaging between 250 and 300 bushels; and wheat, 52 bushels.

This soil has very much the same value and crop adaptations as Portneuf silt loam. A more definite crop rotation, including alfalfa or clover, and the plowing under of straw and manure would help to maintain the organic matter and nitrogen.

The results of mechanical analyses of samples of typical Portneuf very fine sandy loam are given in the table following:

Mechanical analysis of Portneuf very fine sandy loam

Number	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541005	Surface soil, 0 to 1 inch	0.6	0.4	0.3	12.2	59.9	23.4	3.0
541006	Subsurface, 1 to 6 inches	.0	.2	.2	12.2	55.1	25.6	7.2
541007	Subsoil, 6 to 18 inches	.0	.0	.2	7.7	56.4	29.4	6.5
541008	Subsoil, 18 to 40 inches	.0	.0	.2	5.6	55.6	31.6	7.3
541009	Subsoil, 40 to 72 inches	.0	.0	.0	12.6	33.6	45.8	7.5

PORTNEUF FINE SANDY LOAM

The surface soil of Portneuf fine sandy loam is friable, brown or light grayish-brown fine sandy loam about 11 inches deep. Beneath this is a very light grayish-brown or cream-colored compact zone of similar or of slightly heavier texture and of very high lime concentration, which continues to depths ranging from 30 to 40 inches. The deeper subsoil is light brown or light grayish brown and varies in texture from fine sandy loam to fine sand. The deeper substratum, which frequently occurs within 6 feet and in a few places within 3 feet of the surface, consists of a lime-cemented hardpan underlain by basalt bedrock. In the shallower spots small angular fragments of basalt and hardpan and a few small basalt bowlders are present in the soil. The soil material is derived from a great variety of rocks. It has been carried by the wind largely from the river-laid materials of the old terraces.

In a few places the surface is loose fine sand, though this light, loose material usually forms only a thin cover over heavier material.

The total extent of this soil is 3 square miles. It occurs as narrow strips along the edge of the escarpment separating the bench lands from the terrace lands on the north side of Snake River.

Areas of this soil vary from nearly flat to slightly rolling and ridged. Drainage is good, and no alkali accumulations have developed. The water-holding capacity is generally good. A very small area, probably not over 100 acres, is under cultivation. The rest is too high to be watered under the present irrigation system, but may be included in the proposed Minidoka northside pumping unit. Alfalfa, pasture, and grain are now grown. It seems probable that the crop adaptations, yields, and cultural methods described in connection with Portneuf silt loam will be applicable to this soil.

Portneuf fine sandy loam, stratified-substratum phase.—In the stratified-substratum phase of Portneuf fine sandy loam the profile is practically the same as that of the typical soil, except that the substratum is composed of water-laid material of light texture, varying from fine sand to gravelly sand, which in only a few places occurs within 6 feet of the surface. Few gravel fragments are present in the soil.

This soil has a wider distribution than the typical Portneuf fine sandy loam, and has a total extent of about 11 square miles. It occurs chiefly as long, narrow ridges, generally extending from southwest to northeast and rising above the general level of the river terrace on which they occur. There are also comparatively level areas.

Drainage is normally good and the soil is free from alkali, except in small bodies just north of Heyburn, where a high water table exists and where there is a slight concentration of alkali salts on the surface.

The water-holding capacity of this soil ranges from fair to good. The ridged surface and the fact that much of it is at too high an elevation to be watered by gravity ditches, explains why much of this soil is not cultivated. In places so much soil has been removed in the process of leveling as to expose the deep subsoil which is very low in organic matter and generally unproductive. Only a few hundred acres are cropped to alfalfa hay, small grains, potatoes, and pasture. Yields of 2 and 3 tons of hay and 200 bushels of potatoes an acre are reported. Probably very little more of this land will be developed agriculturally, owing to the small extent of the areas and to the necessity of pumping water to irrigate them.

Portneuf fine sandy loam, alluvial-fan phase.—Portneuf fine sandy loam, alluvial-fan phase, has a surface layer 1 or 2 inches thick of light-brown fine sandy loam, forming a soft crust with a vesicular structure. Beneath this, to depths ranging from 8 to 12 inches, is a layer of mellow, brown fine sandy loam, succeeded by rather compact, heavy, very fine sandy loam or fine sandy loam which continues to an average depth of 18 inches. The color of this layer is light brown, with a slightly yellowish tinge. The layers described above do not contain sufficient lime to produce effervescence when treated with hydrochloric acid.

The next layer is light brown or light brownish-gray very fine sandy loam or loam, and is very compact and highly calcareous. At an average depth of 40 inches this layer is underlain by somewhat more friable material of about the same color but fine sandy loam or loam in texture. A small quantity of angular gravel, largely quartzite, is scattered through the soil. The soil material, which is highly micaceous, seems to be a mixture of loessial and alluvial-fan materials in varying proportions, but the finer-textured materials everywhere predominate. The depth to the highly calcareous layer varies considerably. On high exposed points it is encountered within 6 inches of the surface, whereas on lower and flatter ground it is, in places, 3 feet or more below the surface. At the foot of fans, where they flatten out and merge with the flat View soils, small bodies have a heavy loam or clay loam surface layer. Small undifferentiated tracts of View fine sandy loam are probably included with the phase as mapped.

The alluvial-fan phase of Portneuf fine sandy loam is developed as a belt on the alluvial-fan slopes in the southeastern part of the surveyed area, and extends from a point 1 mile southwest of View to the Marsh Creek bottom lands 2 miles southeast of Declo.

The surface varies from flat or gently sloping at the lower edge of the fans to rather steeply sloping and somewhat dissected on the upper parts. Practically all of it could be irrigated. Drainage is normally good, and the soil is practically free of alkali. The water-holding capacity is good.

This does not rank as a very important soil, agriculturally, on account of the small area under cultivation. Less than half of this land is below the present irrigation canals. About 45 per cent, or from 3½ to 4 square miles, is under cultivation, most of it irrigated, although a few hundred acres are dry farmed. Under irrigation alfalfa yields average about 3 tons; wheat yields range from 20 to 40 bushels, averaging about 30 bushels; potatoes from 100 to 400 bushels, averaging about 200 bushels; sugar beets from 8 to 15 tons; barley 45 bushels; and oats 40 bushels. Under dry farming wheat is the main crop, probably averaging 10 bushels or a little more per acre. Some rye is grown. Summer fallowing is practiced on the dry-farmed lands.

Land prices probably range from $75 to $150 an acre for irrigated land, depending on location and improvements.

Crop rotation, including the growing of alfalfa or other legumes, and the incorporation of organic matter, are important measures for the maintenance of the productivity of this soil.

PORTNEUF SILTY CLAY LOAM, BASIN PHASE

The typical silty clay loam of the Portneuf series is not developed in this survey, this soil being represented only by a soil occupying local basins and flats which has been correlated as a basin phase of the typical soil.

Portneuf silty clay loam, basin phase, has a thin vesicular crust-like layer of soft, easily crumbled light-brown silt loam or very fine sandy loam. This layer is underlain by brown or dark-brown, flocculated silty clay loam or heavy silt loam, from 6 to 10 inches deep, which usually contains considerable organic matter. Below this, to a depth of 30 or more inches, occurs a brown or yellowish-brown compact layer of loam or silty clay loam material which has a buckshot structure, underlain by friable, yellowish-brown silt loam or fine sandy loam material. Lime is not present anywhere in the 6-foot section in sufficient quantities to produce effervescence when the soil is treated with hydrochloric acid. The texture of the surface soil varies considerably, small areas of clay being included. Along the edge of the river terrace below the bench lands many bodies of this soil have a fine sandy loam or fine sand surface soil over a heavy subsoil, and would have been mapped separately had their extent been sufficient to justify separation. Rock outcrops and stony spots occur in some of the depressions.

The soil material is outwash materials from areas of Portneuf silt loam and Minidoka very fine sandy loam, though on the terrace lands some of the material may have been laid down by the river. In the sandy portions the surface material has probably been deposited by the wind.

This soil is developed on the north side of Snake River in comparatively small and scattered bodies. It occurs in undrained depressions or as poorly drained coulee bottoms on the bench lands and at the mouths of the coulees where they open on the river terrace. On the bench lands it is most extensively developed northwest, north, and northeast of Paul; and on the terrace lands, the largest bodies are north and northeast of Acequia, at "Cap Hawley Lake" 3 miles north of Rupert, and at the drainage sump 3½ miles northeast of Paul.

The surface is usually almost flat or gently sloping. (Pl. 36, fig. 1.) The soil areas have no surface drainage outlets, but it is probable that there are ground outlets in the form of fissures in the rock substratum. In the lower parts of some of the basins, water stands for several days after a hard rain. Several bodies within the irrigated area have been provided with artificial drainage sumps dug down into the bedrock. Most of the sumps carry the water away, but some of them work so slowly that parts of the surrounding land are submerged after the spring thaw or after heavy rains on the uplands. Very little alkali is present in the soil, but in some of the depressions, bad drainage conditions and alkali accumulations may develop when the bench lands are irrigated. This soil is easily irrigated and will hold large quantities of water.

The basin phase of Portneuf silty clay loam is not an important agricultural soil, because of the small acreage under cultivation. About 1½ square miles is within the boundaries of the present Minidoka gravity unit, and of this probably 80 to 90 per cent is under cultivation. Small patches are too poorly drained to be cultivated. Most of the remainder is included in the proposed Minidoka north-side pumping unit. Alfalfa yields, as reported, range from 2 to 5 tons an acre, averaging about 3½ tons; wheat, from 30 to 35 bushels; potatoes, from 150 to 300 bushels; barley, 35 bushels; oats, from 35 to 40 bushels; and corn, 40 bushels.

Current land values probably range from $100 to $150 an acre.

PAUL LOAM

The topsoil of Paul loam has a surface layer of mellow, brown, heavy loam from 6 to 10 inches deep, underlain by a compact dark-brown layer of either clay loam or clay a few inches in thickness. Both layers contain little lime carbonate. The texture of the upper part of the highly calcareous light-gray or light brownish-gray heavy subsoil is usually silty clay loam, in many places becoming somewhat lighter in texture with depth. The loose sandy substratum is generally from 3 to 6 feet below the surface. Areas in which Paul loam is shallow are comparatively small, and as many of them are in a region of high water table, the depth of the subsoil has little significance and has little effect on the drainage or water-holding capacity. In places, the heavy loam of the surface soil grades downward into fine sandy loam; in others, it approaches clay loam; and small tracts of silt loam, apparently representing wind-laid material but having a heavy subsoil, have been included in mapped areas of Paul loam. Some bodies show some stratification; in others, the lime may be leached to a depth of 3 feet. In some patches, many of them only a few feet in diameter and usually on low ground, the surface layer is tough, deflocculated, and comparatively impervious to air and water. Where the land is in the virgin condition, many of these patches are bare, as plants have difficulty in obtaining a footing on them. Some of these areas contain a rather high alkali concentration and are locally known as "slick" or "buckskin" spots.

The soil material was probably laid down largely by still or slowly moving water, and the coarse substratum was laid down by more swiftly moving water. The surface soil has probably been modified by wind-laid material, and low ridges of wind-borne loessial material occur in places over the heavier water-laid subsoil.

Paul loam is fairly extensive in this area. It occurs most extensively on the lower or western end of the terrace lands on the north side of Snake River, in the vicinity of Paul.

The land is usually flat, though in places it is undulating. The drainage varies from fair to poor. The water-retaining power of the soil is good, and the surface is favorable to easy irrigation either by flooding or by the furrow or corrugation method. Traces of alkali are present in the subsoil of much of this soil, but surface concentrations are not common. The only areas in which alkali accumulations occur are near the river in the vicinity of Heyburn and westward, and on the south side of the river northeast of Burley. Most of this land is under cultivation, though a few bare patches occur. The alkali condition seems to be improving under irrigation, the salts being washed out by the downward percolation of the water, though it may be growing worse on land that lies idle.

Agriculturally, Paul loam is probably the most important soil of the area at present. It is the soil most extensively irrigated and a large part of it, probably from 90 to 95 per cent, is actually under cultivation, the remainder consisting mostly of small, poorly drained, and alkali-affected bodies. The most important crops are alfalfa hay, wheat, potatoes, sugar beets, clover seed, oats, and barley, and a considerable acreage is devoted to pasture. Alfalfa produces from 2½ to 4 tons an acre, with an average of about 3½ tons; wheat, from 25 to 60 bushels, with an average of slightly more than 35 bushels; potatoes, from 100 to 400 bushels, averaging about 225 bushels; sugar beets, from 10 to 15 tons; clover seed, from 2 to 9 bushels; clover hay, about 2 tons; oats, from 35 to 85 bushels, averaging 50 bushels; and barley, from 40 to 50 bushels. The pasturage is mostly of very good quality, consisting of an abundant growth of bluegrass and clover. Many orchards, mostly apple, have been set out; and in years when the fruit is not killed by frost, good crops are produced.

Current land values of Paul loam range from $125 to $250 an acre, depending on location and improvements.

The needs of this soil are much the same as those of the other soils of the area. It is comparatively poor in organic matter, and would be improved by growing alfalfa or clover, and by applying manure.

Where areas of this soil have been leveled, the heavy subsoil material is exposed in patches. These patches, as well as "slick" spots, need special attention. They should be covered with lighter material, deeply plowed, and the soil increased in organic matter. When irrigating, care should be exercised against the possibility of flooding fields of such cultivated crops as beets and potatoes, as a hard crust forms over the surface, which is detrimental to the growth of the plants. The plowing should be done under proper moisture conditions, to prevent puddling and clodding of the soil. When wet this soil is very sticky. In alkali-affected areas, drainage and flooding of the surface are needed to remove the excess salts.

The results of mechanical analyses of samples of the surface soil and three sections of the subsoil of Paul loam are given in the following table:

Mechanical analysis of Paul loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541057	Surface soil, 0 to 6 inches	0.6	4.4	3.0	18.2	22.2	33.6	18.1
541058	Subsurface, 6 to 9 inches	.3	2.4	1.7	9.4	11.0	40.1	35.2
541059	Subsoil, 9 to 40 inches	.0	.8	.8	9.1	8.4	56.0	24.9
541060	Subsoil, 40 to 72 inches	6.3	57.8	12.8	18.2	1.0	2.0	2.1

PAUL FINE SANDY LOAM

Paul fine sandy loam has a surface soil of light-brown or brown fine sandy loam, from 6 to 18 inches in depth, and mapped areas may include some patches of fine sand. This is underlain by a compact brown layer which may be clay loam or clay, and this, in turn, by the heavy, highly calcareous, light grayish-brown or light-gray subsoil characterizing the soils of the series. The upper part of this subsoil is generally heavier, ranging from clay to heavy loam, and grades with depth into somewhat lighter material. It is usually underlain, at depths ranging from 3 to 6 feet, by a loose substratum of fine sand, sand, or gravelly sand. The larger areas, in which this substratum comes within 3 feet of the surface, have been mapped and described as the shallow phase of Paul fine sandy loam.

This soil occurs extensively southwest and west of Rupert and around Heyburn, and small areas are scattered over the greater part of the river terraces on the north side of Snake River.

This land varies from flat to undulating, making it generally favorable for irrigation. The surface drainage is poor or fair and the underdrainage varies from good to poor. Much of this soil occurs on the north side of Snake River, where a high water table prevails. Drainage ditches keep the water table 3 or 4 feet below the surface, except in depressions, where it sometimes rises to the surface. Noticeable concentrations of alkali are present only in the vicinity of Heyburn and west from that town, but areas which are sufficiently affected to injure crops are very small. The content of plant-available water is high except near the deep drains.

Paul fine sandy loam is a fairly important agricultural soil, and probably 90 per cent is under cultivation. A small acreage lies at too high an elevation to be watered by gravity ditches. Alfalfa yields from 2 to 5 tons an acre; potatoes, from 200 to 500 bushels; wheat, from 20 to 50 bushels; sugar beets, from 10 to 15 tons; corn, from 50 to 70 bushels; barley, from 25 to 90 bushels; oats, from 30 to 45 bushels; clover hay, 3 tons; and clover seed, 3 bushels. A small acreage is devoted to pasture and gardens.

This soil is low in humus and nitrogen. A system of crop rotation, including the growing of alfalfa or clover, and the conserving and plowing under of manure and straw, would aid in meeting those deficiencies.

Paul fine sandy loam, shallow phase.—Shallow Paul fine sandy loam has practically the same profile as typical Paul fine sandy loam, except that, in the shallow soil, the porous sandy substratum comes within 3 feet of the surface. The average depth of the surface layer is probably a little greater and the heavy subsoil layer may be very thin. In places, especially where it is closely associated with Rupert sandy loam, it somewhat resembles the latter, which, however, has no heavy calcareous layer.

This soil occurs on terraces in rather small, scattered bodies, in many places associated with the deeper or typical soil. Its total extent is small. The largest single body occurs a short distance below Minidoka Dam, on the south side of the river.

Surface drainage is not well developed, but the underdrainage, except in the belt having a high water table, varies from good to excessive. The power to hold water is lower than that of the deeper soil.

Paul fine sandy loam, shallow phase, gives practically the same or slightly lower yields than those obtained on the typical soil. The cultural methods are practically the same, though more frequent and more bountiful irrigation is probably essential.

PAUL CLAY LOAM

Paul clay loam has a brown surface soil of comparatively friable, flocculated or granulated heavy clay loam, ranging from 6 to 12 or more inches in depth. The subsoil is compact brown clay from a few inches to a foot in thickness, underlain by light-brown or light grayish-brown material, either heavy clay loam or clay, and very high in lime. The underlying substratum is of loose material, which in many places is within 6 feet of the surface, but rarely, if anywhere, within 3 feet. On the north side of Snake River this substratum is composed of clean fine or medium sand, but on the south side it is gravel or gravelly sand.

Paul clay loam occurs as river terrace lands on both sides of the river, and in many places is closely associated with Paul loam. It is most extensively developed northwest of Paul. Its total extent is only a few square miles.

The land varies from flat to undulating and can be easily irrigated. The water-holding capacity of the soil is high. Surface drainage is generally poor or fair and subdrainage varies from poor to good. Those bodies on the south side of the river, south of Springdale, have a loose gravel substratum at a depth of slightly more than 3 feet, and they probably have somewhat excessive subdrainage. Alkali-affected bodies are small and are confined to the low portions that are poorly drained, notably those west of Emerson School.

This soil, on account of its small extent, does not rank as one of the important agricultural soils of the area, but probably 90 per cent or more is under cultivation. Crops and yields are similar to those produced on Paul loam. Good pastures of bluegrass and clover are on this land. Plowing and cultivating should be done when the soil has the proper moisture content, to prevent puddling and clodding. Cultivated crops should not be flooded, as the surface bakes and crusts easily. Irrigations should be heavier and made at less frequent intervals than on the lighter-textured soils. On the more sloping ground it is recommended that a small head of water be run for a long time. Incorporation of organic matter and the proper rotation of crops are important factors in maintaining productiveness.

Land of this kind is probably worth from $100 to $200 an acre.

In the table following are given the results of mechanical analyses of samples of the surface soil and three sections of the subsoil of Paul clay loam:

Mechanical analysis of Paul clay loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541053	Surface soil, 0 to 7 inches	0.7	0.6	0.3	4.1	25.4	41.8	27.3
541054	Subsoil, 7 to 12 inches	.6	1.4	.4	4.2	20.8	43.0	29.8
541055	Subsoil, 12 to 28 inches	1.5	.6	.2	5.6	12.8	37.5	42.1
541056	Subsoil, 28 to 72 inches	.0	.2	.2	4.9	9.9	43.3	42.1

PAUL FINE SAND

Paul fine sand has a surface soil of light-brown or light grayish-brown, loose or very slightly compacted fine sand, to depths ranging from 6 inches to 3 or more feet. The subsurface layer, a few inches in thickness, is composed of dark-brown compact material which varies from heavy fine sandy loam to clay. These two layers are leached of lime or are only very slightly calcareous, and are underlain by a subsoil of highly calcareous, very light grayish-brown or light-gray clay loam material which becomes lighter in texture with depth. The loose calcareous substratum varies in texture from fine sand to gravelly sand and usually occurs from 3 to 6 feet below the surface, though in places it occurs deeper down. Areas of sufficient size in which the loose substratum occurs within 3 feet of the surface have been mapped as a shallow phase of Paul fine sand. The heavy subsoil varies considerably in texture. In some places it is heavy fine sandy loam or very fine sandy loam, in other places clay, and in a few places it is somewhat stratified with sandy materials. Patches of Paul fine sandy loam are included in mapped areas of this soil, also small bodies of Ephrata fine sand, with which it is closely associated.

This soil occurs on the old river terraces, mostly on the north side of Snake River and on the south side between Downards Bridge and Minidoka Dam. The largest area is south of Rupert, extending from Heyburn to Downards Bridge.

Areas of Paul fine sand are generally flat, though in places there are low hummocks and depressions. Surface drainage is poor and subsurface drainage is fair or poor. On account of its heavy subsoil, the soil generally holds a fair quantity of moisture. In places where the water table is high, the irrigation water requirement is not great; but in places where the heavy subsoil is comparatively thin and the water table is lowered by the nearness of drainage ditches, there is need of frequent irrigation. Much of this soil south of Rupert is in a belt having a water table which rises to a level ranging from 2 to 4 feet below the surface in the late summer and fall, and ponds are formed in some of the depressions. The subsoil contains much alkali in some places, especially near the river and in the vicinity of Heyburn. Very little alkali is present in the sandy surface soil, except where the land is very low and wet. In very few places is the concentration sufficient to prove harmful to crops.

Probably from 75 to 80 per cent of Paul fine sand is under irrigation at the present time. The small ridges and knobs which rise above the gravity ditches are not irrigated, and some areas which were previously cultivated now lie idle. The looseness and shifting of the surface soil makes it difficult to irrigate and to obtain crop stands. Alfalfa generally yields well, the yields reported ranging from 1 to 5 tons an acre. Potatoes yield from 100 to 250 bushels an acre; wheat, from 10 to 50 bushels, with an average of about 25 bushels; and sugar beets, about 12 tons. Small acreages of barley, oats, and corn give fair yields.

Like the other sandy soils of the area, where well drained, this is a warm and early soil, suited for truck farming. Climatic conditions and poor markets, however, discourage this industry. The soil is very low in organic matter, so that it may be improved by applications of manure and the turning under of clover or alfalfa. The soil in some areas would probably respond to more water during the peak of the irrigation season. The plowed land should not be left for long periods in the rough, as the surface is likely to be blown by the wind.

Current land value of Paul fine sand ranges from $75 to $200 an acre, depending on improvements and location with regard to towns.

Paul fine sand, shallow phase.—Shallow Paul fine sand has a profile similar to that of typical Paul fine sand, except that the sandy substratum occurs within 3 feet of the surface and the heavy subsoil layer is comparatively thin, in places being only a few inches thick. In many places this soil is closely associated with Ephrata fine sand, and small bodies of the two soils are so mixed as to make consistent separation impossible. Patches of typical Paul fine sand have been included in mapped areas of this soil. This soil occurs as small scattered bodies, the largest being northeast of Jackson. Other important developments occur south and southeast of Rupert.

Paul fine sand, shallow phase, holds less water than typical Paul fine sand. In the belt which has the high water table, subsurface drainage is poor, whereas outside of this belt it is good or excessive. Alkali accumulations are of very small extent.

Nearly all of the soil mapped is under cultivation. Cultural practices and crop yields are similar to those on the deeper soil, though the yields are probably more often reduced by drought. Irrigation at somewhat more frequent intervals is recommended for the shallow soil.

RUPERT SANDY LOAM

Rupert sandy loam, to a depth ranging from 6 to 10 inches, is light-brown loose porous sandy loam. This is underlain by a slightly more compact layer of similar or slightly heavier texture, which grades at depths ranging from 20 to 40 inches into the loose, dark-gray or brownish-gray substratum of sand or gravelly sand. In places there are narrow belts having a surface coating of wind-drifted sand. The soil, to a depth of 6 feet, does not contain sufficient carbonate of lime to react with acid. However, small bodies occur in which a high concentration of lime is present in the subsoil, and some of the lighter-colored particles of the deeper, coarser-textured material are calcareous.

This soil covers a comparatively large area on the upper or eastern end of the terrace lands on the north side of the river. A large unbroken body surrounds Rupert and extends northeast to a point 1 mile southeast of Acequia.

The surface of this land varies from flat to gently sloping or undulating, so that irrigation by flooding may be easily accomplished. Surface drainage is poor to fair. Subsurface drainage is naturally excessive, but in the area around Rupert a high water table has been produced by seepage from higher lands and unlined canals. In most places drainage ditches keep the water table at a depth of 2 or 3 feet, though in some of the depressions the water forms ponds and marshy spots. The fact that the ground water subirrigates the land explains why only 2 or 3 acre-feet of water are necessary for irrigation. Outside of this belt much more water is used, from 4 to 8 acre-feet being allowed, and some excess water is bought. Very little alkali is present in this soil, except in a few low spots where water has not been applied to the surface and where slight surface concentrations occur.

Rupert sandy loam is one of the most important agricultural soils in the area at the present time. Its total extent is nearly as great as that of Paul loam and practically all of it is under cultivation. It produces good yields of all the crops commonly grown in the area. Alfalfa, which occupies a large acreage, yields from 2 to 5 tons an acre, with an average of about 3¾ tons; potatoes, usually an important crop, yield from 100 to 400 bushels, averaging 250 bushels; sugar beets, from 10 to 20 tons; wheat, from 20 to 50 bushels; corn, from 30 to 60 bushels; oats, from 20 to 60 bushels; barley, from 20 to 85 bushels; clover hay, from 1 to 4 tons; and clover seed, from 2 to 6 bushels an acre. Small acreages are in pasture on many farms, and many small orchards produce from 25 to 100 bushels of apples an acre in favorable years. Small acreages of gardens, small fruits, and beans are reported. Considerable sheep feeding and some dairying are carried on.

Current land values probably range from $100 to $400 an acre, depending on improvements and nearness to Rupert.

The growing of alfalfa or clover in rotation with other crops and the application of barnyard manure are essential to maintain the productivity of this soil, as the content of organic matter is low.

Rupert sandy loam, light-textured phase.—Light-textured Rupert sandy loam, to depths ranging from 6 to 12 inches, is light-brown, very light sandy loam which may be loose or fairly firm and contains a sprinkling of dark-gray coarse sand and a small quantity of gravel. The subsoil consists of more compact material which is loamy sand or sandy loam in texture and from several inches to a foot or more in thickness. At depths ranging from 15 to 30 inches it is underlain by a substratum of dark-gray or dark grayish-brown loose sand or gravelly sand. Small undifferentiated areas having loose sandy surfaces and patches of sandy loam are included in mapped areas of this light-textured soil.

Rupert sandy loam, light-textured phase, is not extensive. Its acreage aggregates three square miles. Only two bodies were mapped, one north of Rupert and the other extending southwest from Acequia for about two miles. It occurs on old river terraces between bodies of Rupert sand and Rupert sandy loam.

Areas of this soil are flat or gently sloping and favor easy irrigation. There is no well-developed system of surface drainage, but the subsurface drainage is everywhere excessive. As the water-holding capacity of the soil is very low, the application of a very large quantity of water is necessary for the successful growing of crops. From 5 to 8 acre-feet are allowed on this soil, and excess water is bought by many of the farmers.

Probably 90 per cent of this land is under cultivation. Crop adaptations and yields are about the same as on the more extensive typical Rupert sandy loam, though it is probable that grain yields are slightly lower.

This soil is low in organic matter, which may be supplied by the growing of alfalfa and the incorporation of barnyard manure and green manures.

The results of mechanical analyses of samples of the topsoil and subsoil of typical Rupert sandy loam are given in the following table:

Mechanical analysis of Rupert sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541071	Topsoil, 0 to 6 inches	5.0	23.4	10.6	23.6	16.1	17.5	4.3
541072	Subsoil, 6 to 25 inches	2.8	17.4	11.6	33.7	17.2	11.5	6.2

RUPERT SAND

Rupert sand, to depths ranging from 12 to 40 inches, is loose, light-brown sand containing considerable coarse sand and a little gravel. In many places a slightly loamier and more compact subsoil layer is below this. A substratum of clean, dark-gray sand or gravelly sand occurs at depths ranging from 20 to 40 inches. This is largely basaltic but includes some light-colored rock fragments. The entire soil is comparatively loose and leachy and in most places there is not sufficient lime present to produce effervescence with hydrochloric acid. In some areas there occurs a slight lime accumulation in the subsoil; but where these areas are of sufficient extent they have been mapped as Ephrata fine sand, with which this soil is closely associated in many places. A small area about 1½ miles below the Minidoka Dam on the north side of the river has basalt bowlders scattered through the subsoil and has a thin layer of high lime concentration.

This soil is developed almost entirely on the north side of Snake River as old river-terrace land. The largest body is shaped like a Y with its base about 1 mile below the Minidoka Dam and branching above Acequia, one arm extending west along the base of the escarpment to a point about 3 miles north of Rupert and the other extending southwest along the river to a point 1½ miles above Downards Bridge.

The surface is usually flat, but in some places it is gently sloping and in others it is modified by low hummocks and ridges. Surface drainage is generally poorly developed and subsurface drainage is excessive, except south of Rupert where the water table is high. The soil holds very little moisture. The surface is favorable to irrigation, but the surface soil is so loose that a large head of water is required in order to cover the ground. Frequent irrigation is necessary and the total quantity of water used is very large, except in that region having a high water table. The quantity of water allowed under the zoning system practiced by the Bureau of Reclamation varies from 4 to 8 acre-feet and some of the farmers use excess water obtained by purchase. The records maintained by the Bureau of Reclamation show that as much as 20 acre-feet of water a season have been used on this soil.

Most of Rupert sand has been cleared and cultivated, but it is probable that little over 50 per cent is now under cultivation. This is largely because of the excessive water requirement, together with the difficulty of irrigation, owing to the porosity of the soil, and the trouble in obtaining crop stands on account of the blowing of the surface material by the wind. Some of the lower patches south of Rupert are so water-logged as to be practically worthless. The part now under cultivation is devoted largely to the raising of alfalfa hay and potatoes, with considerable corn and wheat, and some oats, clover hay, alfalfa seed, sugar beets, pasturage, and orchard fruit. Alfalfa hay yields from 2 to 4 tons an acre; potatoes, from 100 to 400 bushels, with an average of about 230 bushels; corn, from 10 to 40 bushels; wheat, from 15 to 35 bushels; and oats, from 20 to 25 bushels.

The current value of this land ranges from $75 to $150 an acre.

Rupert sand is very low in organic matter. For this reason the growing of alfalfa and clover and the plowing under of organic manure is recommended. In irrigating, a large head of water should be run for a short time and at frequent intervals to prevent excessive waste. In view of the very large quantity of water used, it is a debatable question whether this soil should be supplied with water at the expense of other lands which require a smaller quantity.

Rupert sand, bedrock phase.—The bedrock phase of Rupert sand has a loose, light-brown or light grayish-brown surface soil, from 12 to 40 inches deep, which may consist of medium sand or fine sand. In places this is underlain by a slightly loamier and more compact brown subsurface layer, and dark-gray sand or gravelly sand is usually encountered at depths ranging from 2 to 4 feet. A basalt bedrock substratum usually occurs within 6 feet of the surface, in places within 3 feet, and in other places it crops out. Immediately over the bedrock there is, in most places, a thin layer of highly calcareous material. The area on the south side of Snake River resembles Ephrata fine sand more than it does Rupert sand, as the surface soil here is finer textured and the subsoil below 3 feet is normally highly calcareous and of a light-gray or whitish color, though of the same loose and porous sandy material. In places it contains basalt and hardpan fragments washed down from the higher land.

The bedrock phase of Rupert sand occurs along the lower edge of the bench lands on both sides of Snake River below Minidoka Dam. The largest single body occurs on a bench about 1 mile east of Acequia and another large body is 1 mile east of Jackson.

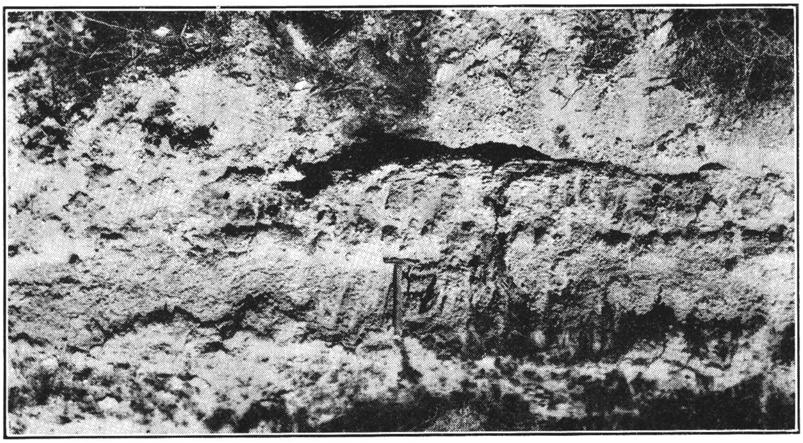
Areas of this soil are gently undulating or sloping. Surface drainage is fairly good and subsurface drainage varies from good to excessive. The water-holding capacity is probably greater than that of typical Rupert sand, though less than that of most of the heavier soils of the area. The soil is fairly easily irrigated, but it requires a large head of water to cover the surface evenly.

This is not an important soil agriculturally, probably somewhat less than half of the area mapped being under cultivation. Most of the idle land lies too high for water, though a small acreage has been farmed and abandoned. The crop yields are about the same as those on typical Rupert sand, and land prices are slightly lower.

This soil requires about the same practices as typical Rupert sand and does not encourage future development under irrigation.

DECLO FINE SANDY LOAM

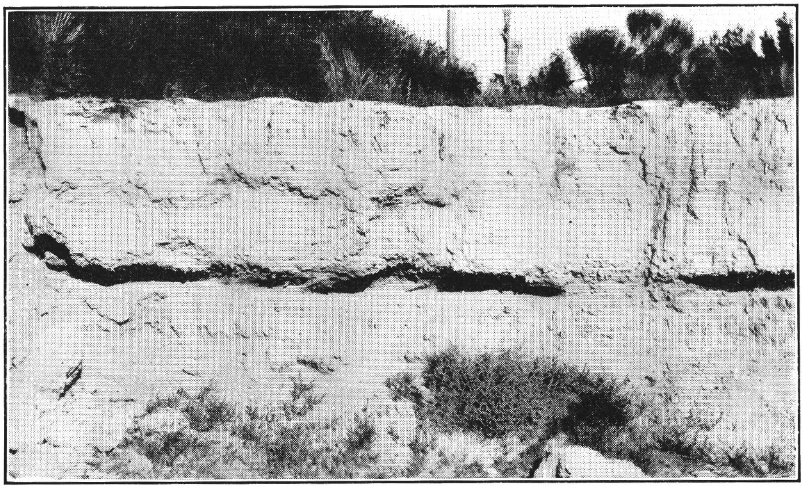
Declo fine sandy loam has a surface soil of friable, brown fine sandy loam, having an average depth of about 8 inches, and varying in content of lime carbonate. Below this, to depths ranging from 30 to 40 inches, is a highly calcareous, compact layer of light grayish-brown fine sandy loam or loam containing lime-cemented nodules, and a deeper subsoil of stratified, compact, and partly cemented materials. (Pl. 37, fig. 2.) The deeper substratum consists largely of porous gravel beds, although bedrock is present under small areas. The gravel may come within 6 feet of the surface and in places within 3 feet. The shallower spots are not of very large extent. A small quantity of gravel is scattered through the upper part of the soil in some places. On lower and flatter ground the subsoil horizon of lime accumulation may be as heavy in texture as clay loam, and in such places the soil resembles Paul loam and Paul fine sandy loam.



NO. 11532

FIG. 1.—PROFILE OF MINIDOKA VERY FINE SANDY LOAM

The hardpan layer, indicated by the hammer, is about 2 feet in thickness and is underlain by friable uncemented material



NO. 12025

FIG. 2.—EXPOSED SECTION OF DECLO FINE SANDY LOAM

This shows the shoulder of compacted subsoil, partly cemented, but without a well-defined hardpan

Declo fine sandy loam comprises the river-terrace lands south of Snake River, being most extensively developed southeast of Burley and eastward to Declo. Small bodies occur along the railroad west of Burley.

Areas of this soil vary from nearly flat to slightly rolling and are suited for irrigation. Surface drainage is good, and subdrainage varies from good to excessive, except in a very few small low patches. With the exception of these poorly drained areas, the soil is free of alkali. Its moisture-holding capacity varies from high to rather low, depending on the depth to the gravel.

This soil ranks as one of the most important soils of the area, and practically all of it is under cultivation. Alfalfa yields, as estimated by the Bureau of Reclamation, range from 2 to 3 tons an acre; sugar beets, from 8 to 18 tons; potatoes, from 100 to 300 bushels; and wheat, from 20 to 52 bushels. Yields of barley, oats, corn, clover hay, and clover seed are fair. Organic matter should be supplied by growing alfalfa or clover and by the use of farm manures.

Declo fine sandy loam, light-textured phase.—In the light-textured phase of Delco fine sandy loam, the surface soil of light fine sandy loam ranges in color from a rather dull brown to light brown. It is from 6 to 12 inches deep and of varying degrees of calcareousness. The subsoil, a uniform layer of light brownish-gray or cream-colored compact fine sandy material, continues to a depth of 2 or 3 feet. Below this are stratified water-laid materials of various grades, which are usually compact and somewhat cemented by lime, and in many places contain thin shell-like plates of hardpan. In most places the substratum beneath this is composed largely of loose gravel or coarse sand, though in small areas basalt bedrock occurs. The gravel in many places comes within 6 feet of the surface, and in small areas within 3 feet, the shallower areas usually occurring as narrow strips along the edges of the terraces. Such areas occur along the eastern edge of the Goose Creek bottoms, south of Burley, and along the brinks of the eastern slopes of the two coulees southeast of Burley. Other small bodies of shallow surface soil are of irregular occurrence. Small strips having a loose sandy surface soil are also included with the phase as mapped. In places, gravel is mixed with the surface soil, especially in the shallower areas.

Light-textured Declo fine sandy loam occurs on the south side of Snake River, west, south, and southeast of Burley, where it comprises a considerable part of the old river terrace. The largest single body is directly south of Burley on the east side of Goose Creek, but the bodies to the eastward are comparatively small and scattered. This soil aggregates about 6 square miles.

Surface drainage is good and the subdrainage varies from good to excessive. The water-holding power is usually fairly good, but in the sandier spots or where the gravel comes within 3 or 4 feet of the surface it is rather low. No alkali accumulations were found.

Probably about 75 per cent of this soil is now under cultivation. Much of the remainder has been cleared and cultivated, but is now lying idle and a small acreage lies at too high an elevation to be watered by the present ditches. Alfalfa yields from 2 to 4 tons an acre; sugar beets, from 10 to 15 tons; potatoes, from 100 to 400 bushels; and wheat, from 20 to 50 bushels. Small acreages of clover, barley, oats, and corn have been grown.

Organic matter, which is lacking in this soil, may be supplied by plowing under alfalfa or organic manures. Little of this land is changing hands at present, but developed land can probably be bought at prices ranging from $100 to $250 an acre, depending on improvements and nearness to Burley.

The results of mechanical analyses of samples of the topsoil and subsoil of typical Declo fine sandy loam are given in the following table:

Mechanical analysis of Declo fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541043	Topsoil, 0 to 8 inches	1.6	4.2	3.4	22.0	34.2	26.8	8.2
541044	Subsoil, 8 to 38 inches	2.1	3.4	3.2	30.8	36.2	19.4	5.3

VIEW FINE SANDY LOAM

The surface soil of View fine sandy loam is from 6 to 10 inches deep and consists of firm but friable, brown fine sandy loam containing some coarse sand and a little gravel. This is underlain by rather compact heavy brown fine sandy loam or loam. At a depth of about 18 inches there occurs a highly calcareous layer, from 1 to 2 feet thick, forming a hardpan which in places is hard and firmly cemented but in most places is comparatively soft, fragmentary, and intermittent. It is probable that roots and moisture penetrate it to some extent in most places, but it no doubt limits root penetration and probably causes more rapid drying of the overlying soil. The underlying substratum is a bed of porous gravel which has a very uneven surface, occurring in places within 2 or 3 feet of the surface, or directly below the hardpan, and in other places 6 feet or even more beneath the surface. In the deeper spots, a mellower material, usually of fine sandy loam texture, is present between the hardpan and the gravel. The hardpan is generally better formed on the higher ground, whereas it is lacking in many of the slightly lower spots.

This soil is found in the southern part of the area, on a low terrace east of Goose Creek. The largest body extends from near the east edge of the Goose Creek bottoms eastward to the alluvial fans of the foothills of Goose Creek Mountains. The total area is more than 20 square miles.

Areas of this soil range from flat to gently undulating and are favorable for irrigation. Surface drainage varies from good to poor. Subdrainage, which is naturally excessive, has been somewhat modified by irrigation. The porous substratum has gradually become filled with water and in some of the lower lands the ground water rises almost to the surface late in the irrigating season. The soil has a rather low moisture-holding capacity, and over much of the area crops suffer somewhat from drought in midsummer, and "burned-out" spots are common.

About 80 per cent of the View fine sandy loam mapped in the area is included in the Minidoka southside pumping unit, and practically all of this is now under cultivation. Alfalfa, wheat, potatoes, and sugar beets rank in importance about in the order named. Considerable acreages of clover seed, clover hay, barley, and oats are grown. Alfalfa yields from 1½ to 3 tons an acre; wheat, from 15 to 40 bushels, with an average of 27 bushels; potatoes average slightly less than 200 bushels; sugar beets average about 10 tons; clover seed yields from 5 to 8 bushels; barley, from 35 to 40 bushels; and oats, from 35 to 60 bushels.

Current land prices range from $75 to $150 an acre.

Provision for draining some of the lower-lying areas may soon be necessary. Deep open drains, like those in use on the Minidoka gravity unit would probably prove beneficial. Like most of the other soils of the area, View fine sandy loam is low in organic matter, which can best be supplied by growing alfalfa or clover in rotation with other crops and by plowing under manures.

View fine sandy loam, light-textured phase.—The light-textured phase of View fine sandy loam, to depths ranging from 6 to 10 inches, is light-brown or light grayish-brown friable, loose, light fine sandy loam, and below that, to a depth of 18 inches, is brown or yellowish-brown, fairly compact, heavier fine sandy loam. These first two layers contain little lime but are underlain by a layer of high lime concentration, 1 to 2 feet in thickness, which forms a soft and intermittent hardpan. This usually is underlain by loose gravel or gravelly sand, although in places a thin intervening layer of finer-textured material is present. A small quantity of gravel is scattered through the upper part of the soil.

This soil is not extensive. It occurs along the east side of the Goose Creek bottom lands near the southern edge of the area. Another body, also along the southern boundary, is 6½ miles south of Milner.

Areas of this soil range from flat to gently sloping or undulating. Surface drainage is rather poor and subdrainage varies from good to excessive. The hardpan layer is rarely impervious enough to prevent the downward passage of water, though it may retard it somewhat. The soil holds water poorly, owing to the comparatively light-textured, thin soil layer above the hardpan, and to the porous substratum.

This is not an important soil agriculturally, on account of its small extent and because only about 50 per cent, or less than 1 square mile, is under irrigation. Alfalfa, potatoes, wheat, and sugar beets are the principal crops. The yields are about the same or slightly lower than on View fine sandy loam, and cultural methods, land prices, and recommendations for improvement are also the same.

The results of mechanical analyses of samples of the topsoil and subsoil of typical View fine sandy loam are given in the following table:

Mechanical analysis of View fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541090	Topsoil, 0 to 6 inches	1.8	6.2	5.0	31.6	23.7	22.4	9.7
541091	Subsoil, 6 to 18 inches	1.7	4.8	4.6	31.6	20.6	21.7	15.1

GOOSE CREEK CLAY LOAM

Goose Creek clay loam has a surface layer, a few inches deep, of friable, light brownish-gray loam. Beneath this a layer of granular or flocculated dark grayish-brown or black heavy clay loam is underlain by irregular strata of dark brownish-gray or dark-gray material, either clay loam or clay, alternating with somewhat lighter-colored and lighter-textured material. Below 3 feet the color is mainly light brownish gray, though thin and somewhat darker layers appear here and there. This stratified subsoil material varies from very fine sandy loam to clay loam and is highly micaceous. The color of plowed surface soil is usually dark gray. Thin gravelly strata are present, but the gravel is so well mixed with the finer material that it has little effect on the physical properties of the soil. The soil material, to a depth of 6 feet, is normally so low in lime carbonate that no effervescence takes place when it is treated with hydrochloric acid, but in some places it is distinctly calcareous below a depth of 2 or 3 feet. Such an area comprises the northern and eastern parts of the Burley town site.

The largest body is along Goose Creek, extending from the stream north and northeast of Burley to the southern boundary of the area, and ranges from three-fourths of a mile to more than 2 miles in width.

The surface varies from flat to gently sloping and is favorable to irrigation. Surface drainage varies from fair to good and subsurface drainage is apparently good. Very little alkali is present. The water-holding capacity is high.

About 70 per cent of Goose Creek clay loam lies below the ditches of the Minidoka southside pumping unit or the private ditches from Marsh Creek. Practically all of this, except the body occupied by the town site of Burley, is under cultivation. It is very productive and ranks among the most important agricultural soils of the area. It produces from 3 to 3½ tons of alfalfa hay an acre; from 200 to 500 bushels of potatoes, averaging about 330 bushels; from 25 to 60 bushels of wheat, with an average of 37 bushels; from 12 to 30 tons of sugar beets, averaging over 15 tons; from 40 to 65 bushels of oats, and 40 bushels of barley. Small acreages are devoted to pasture, clover, onions, and orchards.

Current land values range from $150 to $300 an acre, depending on location and improvements.

This soil is much richer in organic matter than the lighter-colored soils of the area and is not so much in need of manures and crop rotations, though these practices are essential to maintain soil fertility.

GOOSE CREEK SILTY CLAY

Goose Creek silty clay has a surface soil of granular, friable dark gray silty clay. The upper part of the subsoil contains strata of compact, very dark gray, heavy clay loam or clay. The deeper subsoil like that of Goose Creek clay loam, varies in texture from very fine sandy loam to clay loam and is light gray with a slight yellowish tinge. The soil material to a depth of 6 feet is normally not sufficiently calcareous to respond to the test for lime with hydrochloric acid.

This soil occurs on the lower areas in the Goose Creek and Marsh Creek bottom lands and is generally surrounded by bodies of Goose Creek clay loam. The total extent is but a few square miles. The surface is flat and surface drainage is in many places not well developed, but subsurface drainage is generally good. Very little alkali is present.

On account of its small extent this is not a very important agricultural soil. About 75 per cent of this soil mapped is supplied with water and practically all of this is under cultivation. It produces yields similar to those on Goose Creek clay loam, and cultural methods are about the same. This soil is heavy and special attention should be given to time of plowing and working to avoid puddling and clodding.

Land prices vary from $150 to $250 an acre.

The following table shows the results of mechanical analyses of samples of the surface soil and subsoil of Goose Creek silty clay:

Mechanical analysis of Goose Creek silty clay

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5410107	Soil, 0 to 9 inches	0.8	0.3	0.2	5.9	4.4	54.3	34.4
5410108	Subsoil, 9 to 19 inches	1.6	.3	.3	8.6	9.1	36.1	44.4
5410109	Subsoil, 19 to 72 inches	.8	1.0	1.2	28.0	9.4	44.1	14.5

EPHRATA FINE SANDY LOAM

Ephrata fine sandy loam to depths ranging from 6 to 10 inches is friable light-brown fine sandy loam, underlain to depths ranging from 20 to 40 inches by slightly more compact brown fine sandy loam. A thin zone of high lime concentration, in which the material varies in texture from gravelly sand to fine sandy loam, or in a few places to clay loam, is underlain by a loose substratum of dark-gray sand or gravelly sand, in which some of the material is lime coated or is calcareous. A small amount of gravel is usually scattered throughout the soil.

This soil occurs on old river terraces, chiefly on the south side of Snake River, though small bodies are on the north side. The largest area is southwest and west of Burley, extending for a distance of nearly 2½ miles westward from the Oakley branch of the Oregon Short Line Railroad. On the north side of the river small tracts are south, west, and north of Rupert.

Though generally flat some areas are in places slightly rolling or undulating and are easily irrigated. Surface drainage varies from good to poor. In the higher areas, including probably 75 per cent of the soil, the subdrainage is good or excessive; but in the lower parts, such as those on coulee bottoms, a high water table has developed. The moisture-holding capacity ranges from fair to poor, and the water requirement is rather high, except in the more poorly drained areas.

Probably 90 per cent of Ephrata fine sandy loam is under cultivation, and produces fairly good yields of most of the crops common to the area. Alfalfa hay yields from 2 to 3 tons an acre, wheat from 15 to 45 bushels, potatoes from 100 to 400 bushels, sugar beets from 10 to 14 tons, barley from 30 to 40 bushels, and oats from 40 to 60 bushels. Yields are doubtless somewhat less on the more droughty areas, owing to lack of water in late summer; dried-out or "burnt" patches are numerous in some fields. Sometimes alfalfa is allowed to go without irrigation.

Current land values range from $75 to $250 an acre, depending on location and improvements.

The supply of organic matter is low, and can be built up by growing alfalfa and clover, and by plowing under barnyard manure. Drainage is needed in some of the lower areas, and could probably be effectively accomplished by digging deep ditches similar to those now in use on the Minidoka northside gravity unit.

The following table shows the results of mechanical analyses of samples of the surface soil and subsoil of Ephrata fine sandy loam:

Mechanical analysis of Ephrata fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541081	Surface soil, 0 to 8 inches	2.3	4.2	2.0	21.6	39.1	23.2	8.3
541082	Subsoil, 8 to 26 inches	2.4	4.0	2.4	29.6	29.2	21.4	10.6

EPHRATA FINE SAND

Ephrata fine sand, to a depth of 6 or 8 inches, is light-brown friable or loose fine sand, underlain to depths ranging from 15 to 30 inches by slightly more compact brown fine sand, grading downward in places into fine sandy loam. A thin layer of high lime concentration, light grayish brown in color, occurs at depths ranging from 30 to 40 inches immediately over the loose, porous substratum of dark-gray sand or gravelly sand. Where this soil is closely associated with the shallow phase of Paul fine sand, a thin layer of heavy material is present in the subsoil. In general, however, the soil material is light in texture and porous.

Ephrata fine sand occurs on the river terraces, mostly on the north side of Snake River, and usually occurs as narrow strips between bodies of Rupert, Paul, and Winchester soils. The largest bodies are southeast and south of Rupert, extending westward from Downards Bridge. The total extent is but a few square miles.

Areas of this soil are usually flat or slightly modified by low ridges, hummocks, and depressions. Surface drainage is poor. As in the case of Rupert sandy loam, the underdrainage is naturally excessive; but much of this soil is in a region where high ground water has developed, the result of seepage of irrigation water from higher land. Those areas which are not in this belt require from 2 to 4 acre-feet of water for the successful growing of crops. Many of the depressions in the poorly drained sections form ponds or marshes when the water table rises late in the summer. Little alkali is present, except in these lower spots, where a slight surface concentration occurs.

Ephrata fine sand, on account of its small extent, is not of great importance agriculturally. Probably about 75 per cent of the total acreage is under cultivation. The rest of this land is not utilized because of bad drainage and also on account of the excessive moisture requirement and the tendency of the surface soil to blow. Alfalfa, which is the most common crop, yields from 2 to 4 tons an acre, with an average of about 3 tons; potatoes yield from 100 to 150 bushels; wheat, from 10 to 40 bushels; sugar beets, about 10 tons; and corn, from 10 to 30 bushels. Small acreages of clover, barley, and oats are grown.

Current land values range from $75 to $150 an acre.

This soil is low in organic matter. The supply can be increased by growing alfalfa or clover in rotation or by the application of barnyard manure. Plowed land should not be left in the rough for long periods, as the surface blows badly.

The following table gives the results of mechanical analyses of samples of the surface soil and subsoil of Ephrata fine sand:

Mechanical analysis of Ephrata fine sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541085	Surface soil, 0 to 6 inches	3.0	13.0	7.2	52.4	10.8	7.2	6.1
541086	Subsoil, 6 to 18 inches	2.8	11.4	6.7	52.8	13.9	6.8	5.6

ONYX SILT LOAM

The surface soil of Onyx silt loam is brown silt loam which ranges in depth from 18 to 60 inches. The light grayish-brown upper part of the subsoil is compact and very high in lime, and the deeper part varies in texture from fine sand to clay loam and in consistence from very friable to somewhat compact. Basalt occurs only rarely within 3 feet of the surface.

This soil is found on comparatively narrow flats along the coulees which drain the uplands or at the mouths of these coulees where they debouch on the old river terraces. It occurs largely on the north side of Snake River, though small bodies are on the south side in the vicinity of Milner. The largest bodies are a few miles northwest of Minidoka, north of the main line of the Oregon Short Line Railroad, where the bottoms spread out in places to a width of more than one-half mile.

The land is flat. Surface drainage is generally fairly good, as the stream channels are in most places several feet below the flats, though in some places they are obstructed and small sinks occur. Subdrainage is fair or poor. It is possible that a condition of poor drainage may develop in some places when the higher lands are irrigated. Overflow sometimes occurs for short periods after heavy rains or spring thaws. The surface is favorable for irrigation and the soil will hold much moisture. At present no alkali accumulations occur.

The native vegetation consists predominantly of a rank growth of sagebrush, a little rabbit brush, a good growth of western wheatgrass, and some lupine.

Probably about 640 acres of this soil is under cultivation, the remainder being above the present irrigation ditches. A large acreage may be brought under irrigation when the proposed Minidoka northside pumping unit is completed. The soil is very productive, and crop yields probably average somewhat higher than on the associated Portneuf silt loam.

This soil needs organic matter, though it is somewhat higher in this constituent than many of the soils of this area.

MINIDOKA VERY FINE SANDY LOAM

Minidoka very fine sandy loam has a surface appearance very similar to that of Portneuf silt loam and its profile is similar to that of Portneuf very fine sandy loam above the hardpan layer. It has the same thin, friable, light-colored surface layer, the same brown layer extending to an average depth of about 10 inches and grading into lighter-colored, highly calcareous, and rather compact material. This continues downward to the hardpan which occurs at an average depth of about 20 inches. The hardpan, like that of other soils of the Minidoka series, consists of thin, firmly cemented plates, forming layers in the interstices of which is looser material. This hardpan layer is usually from 12 to 18 inches thick (pl. 37, fig. 1), and in many places a second similar layer occurs several inches below the first. The material beneath the hardpan, though soft by comparison, is very compact and somewhat cemented by lime. It is light grayish brown or gray, in many places having a reddish tinge. The texture of this subsoil material, though difficult to determine on account of the cementation, seems to be very fine sandy loam or silt loam. This soil is developed over lava beds whose surface is very uneven, and it contains many shallow patches and rock outcrops.

The shallow patches, where of sufficient size, have been mapped as a shallow phase of Portneuf silt loam. The smaller rock outcrops have been indicated on the map by rock-outcrop symbols, and the larger ones have been mapped as scab land. In most places the soil material is more than 6 feet deep, and in some places cuts 20 or more feet in depth show no bedrock. The hardpan varies considerably in thickness, in places being intermittent and imperfectly developed.

This soil occurs most extensively on the bench lands around Minidoka and northwestward along the main line of the Oregon Short Line Railroad. It is also extensively developed along the southern edge of the area, extending west from the Goose Creek bottoms almost to the Twin Falls County line. It is adjacent to and usually at slightly higher elevations than Portneuf silt loam.

The surface varies from nearly flat to strongly rolling. For the most part it is favorable for irrigation, though some areas are somewhat too rough and steep for the most efficient distribution of water. Surface drainage is good, but the underdrainage is impeded. The moisture-retaining capacity of the soil is fair, though it is restricted by the proximity of the hardpan layer to the surface. Alkali accumulations do not occur at the present time, though patches may become affected after the land is brought under irrigation.

At present this is not an important soil agriculturally. Only about 200 acres of it is irrigated. Several thousand acres have been cleared for dry farming, but practically all has been abandoned. Wheat yields under dry-farming methods range from 5 to 15 bushels an acre and rye about the same. The irrigated land is producing alfalfa, grain, potatoes, and sugar beets. The agricultural value is apparently much the same as that the shallow phase of Portneuf silt loam, though its comparative freedom from stones makes it more favorable for cultivation. A large acreage may come under irrigation on the Minidoka northside pumping unit (Minidoka extension).

MINIDOKA FINE SAND

Minidoka fine sand has a surface layer, from 6 to 12 inches deep, of light-brown or light grayish-brown friable fine sand. It is leached of lime or is mildly calcareous. Under this, to an average depth of about 18 inches, is a layer several inches thick of highly calcareous, rather compact, and very light grayish-brown or cream-colored fine sand or fine sandy loam which contains lime-cemented nodules. This layer is underlain by a lime-cemented hardpan consisting of layers of closely fitting, platelike fragments between which looser material is present, the whole forming a stratum of variable thickness, probably averaging about 15 inches. Under this hardpan is a softer but decidedly compact material, light brown in color and ranging in texture from fine sandy loam to silt loam, in which the granules are partially cemented together by lime. Hardpan fragments are scattered through the upper part of the soil. The deeper substratum is a bed of basalt rock with a very uneven surface. Rock outcrops and small shallow spots are of frequent but irregular occurrence, and between these the soil material in many places extends to a depth of 10 or more feet. Most of these rock outcrops are indicated on the map by outcrop symbols.

In places, especially on the lower ground, the loose sandy surface material may extend to a depth of 3 feet. Bodies where it is deeper, if of sufficient extent, have been mapped as Winchester fine sand. In the shallower areas many basalt fragments and small bowlders are present. Moisture is present in the deep subsoil of this as well as in the other soils of the series.

Minidoka fine sand occurs on the bench lands which border the old river terraces on the east. It is most extensively developed on the bench above the main Southside Minidoka Canal, southwest of Minidoka Dam. Smaller bodies are on the north side of Snake River north and northwest of Minidoka Dam. It is closely associated with the loamy phase of Minidoka fine sand and is developed mainly in long narrow strips running in a general southwest to northeast direction and alternating with bodies of that soil. The total area is about 6 square miles.

The surface varies from nearly flat to somewhat rolling and it is not unfavorable to irrigation except where it is broken by rock outcrops. The power to hold water is limited by the coarseness of the soil material and the nearness of the hardpan to the surface. Surface drainage is good, but the subdrainage is somewhat retarded.

The natural vegetation consists largely of rabbit brush and some sagebrush. Very little of this soil lies under the present irrigation ditches. Very few acres are under cultivation and a small acreage, once irrigated and farmed, has been abandoned. This soil on the north side of the river will probably come under the Minidoka northside pumping unit. The sandy surface soil has a tendency to blow, and as is the case with the other light-textured soils, this would interfere with obtaining stands of some crops and would necessitate special care in plowing and cultivation. Because of the prevalence of rock outcrops, the low moisture-holding power, and the tendency of the surface material to blow, this does not seem a desirable soil for future development under irrigation.

Minidoka fine sand, loamy phase.—Minidoka fine sand, loamy phase, has a surface soil, from 6 to 12 inches deep, of brown or light grayish-brown loamy fine sand, rather friable and containing insufficient lime to produce effervescence when treated with hydrochloric acid. This fine sand grades downward into lighter brown, distinctly calcareous material, either fine sand or light-textured fine sandy loam, which, at a depth of about 15 inches, is compact, has a high lime concentration, and contains lime-cemented nodules and lumps. This is underlain, about 20 inches below the surface, by a lime-cemented hardpan. The deeper material is compact, highly calcareous and slightly cemented and of a light grayish-brown or light-gray color, having in many places a slight yellowish or pinkish tinge. The underlying substratum of basaltic rock is very uneven, and numerous and irregular rock outcrops occur, the majority of which have been indicated on the map by rock outcrop symbols. Small undifferentiated bodies of typical Minidoka fine sand are included with this soil as mapped.

This soil is found on the benches southwest, northwest, and north of Minidoka Dam, closely associated with typical Minidoka fine sand.

The land varies from fairly flat to slightly rolling. Surface drainage is good, but underdrainage is restricted. The thinness of the soil mantle above the hardpan limits its power to hold moisture.

Probably less than 100 acres of this soil is under cultivation, though a small acreage has been cultivated and later abandoned. Most of it is above the present canals. That which is on the north side of Snake River will come under the Minidoka north side pumping unit, and under irrigation will probably produce most of the crops commonly grown in the area.

The many rock outcrops, as well as the shallowness of the soil, will render the greater part of the loamy phase of Minidoka fine sand ill fitted for development under irrigation, though small areas adjacent to better soils may probably be irrigated with fair success. Organic matter is needed by this soil and could be supplied by growing alfalfa and clover and plowing under organic manures.

The following table shows the results of mechanical analyses of samples of the surface soil and subsoil of typical Minidoka fine sand:

Mechanical analysis of Minidoka fine sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
541036	Surface soil, 0 to 8 inches	0.8	5.6	12.7	51.8	17.4	.77	4.1
541037	Subsoil, 8 to 15 inches	.7	3.4	9.1	46.2	18.4	15.5	7.3

MINIDOKA FINE SANDY LOAM, ALLUVIAL-FAN PHASE

The fine sandy loam member of the Minidoka series of soils was not recognized in this survey, this type of soil being represented only by an alluvial-fan phase.

This soil, to a depth of 18 inches, is friable, brown fine sandy loam, slightly more compact in the lower portion. This is underlain by a hardpan layer consisting of cemented materials of different textures, in many places containing a large quantity of angular gravel and small stones. This hardpan layer continues to an average depth of 40 inches and is underlain by rather friable stratified materials of varied texture, but containing slightly cemented strata. The material is probably of mixed alluvial-fan and loessial origin.

This soil occurs on the upper parts of the alluvial-fan slopes above Portneuf fine sandy loam, alluvial-fan phase, and as narrow strips and ridges running through bodies of that soil. A number of such strips occur also along the lower edges of the fans. The surface varies from gently sloping on the lower alluvial-fan slopes to steep and rather badly dissected on the upper slopes. In most places it is favorable for irrigation. The upper, steeper slopes are high above any present water supply, and some places might be rather difficult to irrigate.

The water-holding power is restricted by the thinness of the soil mantle over the hardpan, and the soil dries out rapidly. Surface drainage is good, but underdrainage is probably impeded, though not altogether checked, by the hardpan layer. Small bodies of this soil just below the canals have become affected by seepage and a surface concentration of alkali has formed; but with the exception of these spots, the soil is practically free from alkali.

Only a few hundred acres of this soil are under cultivation. The same crops are grown as on the associated alluvial-fan phase of the Portneuf fine sandy loam and the yields are probably only slightly lower.

WINCHESTER FINE SAND

Winchester fine sand has a topsoil, from 30 to 60 or more inches deep, of loose and shifting fine sand. The color varies from light brown to grayish brown, depending on the proportion of black basaltic material and of brown and light-colored sand grains of which the soil is composed. The subsoil is slightly more compact, highly calcareous light grayish-brown material which varies in texture from fine sand to loamy fine sand. The entire soil is normally loose and open, though in places heavier and more compact materials are present in the deeper part of the subsoil. In general the surface soil is not sufficiently calcareous to effervesce with hydrochloric acid, but in some bodies close to the river, southwest of Heyburn and north of Jackson, the surface is distinctly calcareous, probably owing to calcareous sands blown from the river banks and bars. The substratum under most of this soil consists of stratified river deposits, usually 6 or more feet below the surface, but a basalt bedrock substratum occurs on the bench and along its foot. The surface of this bedrock is very uneven, so that numerous outcrops occur; but in many places the sandy material continues to a depth of 6 or more feet.

This soil occurs mainly as small scattered bodies, in many places forming narrow, dunelike ridges. It is most extensively developed on the river terraces on the north side of Snake River from Paul eastward, and on the adjacent bench lands to the north and east. Small bodies occur on the east side of the river, in the eastern part of the area surveyed. This soil aggregates about 10 square miles.

The land is rather ridged and rolling, though some fairly level areas occur. Surface drainage is not especially well developed but subsurface drainage is excessive. The soil holds very little moisture.

Although a large part of Winchester fine sand occurs within the Minidoka irrigation project, probably not more than 25 per cent of it has been cultivated and probably two-thirds of this is at present idle. The excessive moisture requirement of this soil and the fact that it occurs on ridges and knobs above the general level of the surrounding lands and irrigation ditches account for the small acreage under cultivation and make it undesirable for future development under irrigation. The occasional shifting of the surface material by the wind makes it difficult to obtain crop stands. An additional acreage will come within the boundaries of the Minidoka extension, or north-side pumping unit. Where sufficient water is supplied, this land produces fair crops of alfalfa, beets, and potatoes.

SNAKE CLAY LOAM

The topsoil of Snake clay loam is dark grayish-brown or dark-gray clay loam, high in organic matter, and from 6 to 10 inches deep. The layer below, several inches in thickness, consists of lighter grayish-brown silty clay loam material, and at a greater depth the material is light gray or light grayish brown and of medium or heavy texture. The entire soil is distinctly calcareous, the subsoil probably slightly more so than the topsoil.

This soil is found on narrow low flats or river flood plains, which occur at intervals along Snake River, and it also occurs on a number of islands in the river. Drainage is poor and the water table is high. This soil contains a large quantity of alkali salts, surface concentrations of 3 per cent or more being present in patches. The soil is not inundated annually, but in years of unusually high water much of it is submerged for a short time. Irrigation of higher lands causes the ground water to rise very high in the late summer and fall, and ponds and marshy spots are numerous. The native vegetation consists largely of salt grass, foxtail, greasewood, and willows. Drainage might be successfully effected by ditches running along the inner edges of the river flats, at the foot of the slope from the higher lands. With proper drainage, the excess alkali salts could probably be washed out of the soil.

Very little of the Snake clay loam is under cultivation. Small patches are used as gardens and for the production of corn. Practically all of the soil is devoted to pasture, the native grasses furnishing a rather meager and unpalatable forage. The high content of organic matter should render this soil very productive under irrigation, provided the salt concentration could be kept sufficiently low.

SCABLAND

Scabland includes lands which have so much outcrop of basaltic rock as to be unfit for cultivation. The surface of the lava beds in the region is very uneven and the outcrops are irregular. Where they are small and isolated they have been designated on the map by rock outcrop symbols, but where they are of greater extent they have been shown with small adjacent or included bodies of soil as scabland. Small flats or patches of shallow soil are numerous in the scabland areas, and there are spots where the soil mantle is rather deep, but these patches rarely cover more than a few acres and are usually too small to be indicated on the map. The soil material is similar to that of Minidoka, Portneuf, Winchester, or Rupert soils, depending on the locality in which the scabland occurs. It furnishes some pasturage.

ROUGH BROKEN AND STONY LAND

Rough broken and stony land includes those lands outside of the foothill belt which have too rough and too uneven a surface or which have too many stones or rock outcrops to allow cultivation. It includes the steeper slopes which occur in association with Minidoka very fine sandy loam; the rougher areas associated with Portneuf silt loam,[4] which contain sufficient stones to prevent leveling; rolling or steep areas which include considerable rock outcrop, loose stones, and shallow spots, as along the edge of the escarpment between the bench lands and river terraces; and escarpments along the lower edges of the high terrace lands on the south side of the river. In many places on this kind of land some grass grows, so that this land has some value for grazing.

ROUGH MOUNTAINOUS LAND

Rough mountainous land includes a narrow belt of foothill land along the southeastern boundary of the area, which is predominantly too steep and badly dissected for cultivation. It contains small areas of rock outcrop, but most of the hills have a fairly good covering of soil material, and small areas are included which, were they of sufficient extent, would have been mapped as alluvial-fan phases of Portneuf fine sandy loam and Minidoka fine sandy loam. A rather scant growth of grass covers much of the land, and thus it furnishes some pasturage.

IRRIGATION, DRAINAGE, AND ALKALI

Irrigation is necessary to the continued successful production of all crops grown in the area. Crops of wheat and other grains are occasionally raised according to dry-farming methods, but the practice is profitable only in years of favorable rainfall. Practically every soil in the area would produce good yields of the common crops of the region, provided sufficient irrigation water were supplied.

The greater part of the irrigated land is within the boundaries of the Minidoka irrigation project of the United States Bureau of Reclamation. At the time of this survey (1923) this project comprised the Minidoka northside gravity unit and the Minidoka southside pumping unit. The northside gravity unit has an estimated total irrigable acreage of 71,997 acres, of which 58,133 acres were in crops in 1922. The southside pumping unit comprises 48,126 acres of irrigable land, 42,285 acres of which were cropped in 1922. The small pumping project of the Murtaugh district irrigates a few hundred acres within this area, but this district extends beyond the

[4] The sloping phase of Portneuf silt loam is differentiated from rough broken and stony land by the greater depth of the soil material and the possibility that it may be leveled or terraced for cultivation.

limits of this survey. A small acreage of land included in the present survey is irrigated from Marsh Creek.

The proposed Minidoka extension, or Minidoka northside pumping unit, which is planned by the Reclamation Bureau, has an estimated irrigable area of 115,000 acres, though this area may be decreased somewhat by excluding some of the poorer lands. A private irrigation enterprise, called the Hansen Butte project, may irrigate several square miles of land lying south of Snake River around Milner and to the west of the Minidoka project.

The moisture-holding capacity of the different soils of the area varies greatly, owing to differences in the texture and depth of soil material and to the degree of compactness or porosity of the substrata.

The height of the water table under some of the irrigated land has a marked effect on the requirement of water for surface irrigation. Where it is only a few feet below the surface, subirrigation takes place. This occurs in the southern part of the Minidoka gravity unit, around Rupert and between that city and Snake River. It is reported that under this unit 1,000 acres were damaged by seepage water during the year 1923, and 30,000 acres with impaired drainage are protected to a greater or less extent by drains.

On the Minidoka northside gravity unit, a zoning system is used in apportioning irrigation water, the land in each zone having a certain water allowance. The different zones are allowed quantities of water ranging from 2 to 8 acre-feet, but water in excess of the allotted quantity may be bought when it is available. On the southside pumping unit approximately 2 acre-feet have been allowed. Excess water is available early and late in the season, but at the height of the irrigation season in midsummer only allotted water can be delivered, so that crops sometimes suffer to some extent from drought. A rotation system of water distribution is used.

In general, the soils which have high water requirements are Winchester fine sand, Rupert sand, the better-drained Rupert sandy loam, the higher and more excessively drained Ephrata fine sand and Ephrata fine sandy loam, shallow Paul fine sand and Paul fine sandy loam, where they do not occur in a region having a high water table, the shallower spots of Declo fine sandy loam and its light-textured phase, and much of the View fine sandy loam. The shallow Portneuf silt loam and the Minidoka soils require rather frequent irrigation, though the total quantity of water required may not be large. The Portneuf, Paul, Snake, and Goose Creek soils and much of the Declo soils generally have high moisture-holding capacities.

Drainage is an important problem in parts of the area. A belt in which a high water table has been developed by irrigation occurs on the north side of Snake River, running almost parallel to the river. In this section an extensive system of deep, open ditches has been constructed to keep the water down to a safe level, and in most places it has accomplished this, but small, low areas are still waterlogged. Ditches have been dug to drain the low lands west of Paul, and there are a few short drains in the lower lands on the south side of Snake River. Until very recently drainage has not been necessary on most of the land south of the river, but the water table has been gradually rising, and low areas along the coulees have become so wet in the fall that difficulty is experienced in getting on the land to harvest the crops. Land near to and below the canals has also become affected by seepage. Depressions on the north side of the river have been drained by artificial sumps. When the bench lands are brought under irrigation, drainage problems may arise. The lower lands now under cultivation and the depressions and coulee bottoms above the present ditches may become affected by seepage, so that further artificial drainage may be required.

The alkali content of most of the soils of the area is low under original desert conditions, and it has not been increased to a great extent by irrigation. Snake clay loam is the only soil which is seriously affected. It is poorly drained and most of it contains a considerable quantity of alkali, though the concentration occurs largely within a depth of 2 feet below the surface. It seems probable that this soil might be reclaimed by proper drainage or by washing out the excess salts. The Paul soils, which occur near the river, especially in the vicinity of Heyburn and westward, contain considerable alkali, but only in small areas is the concentration sufficient to be harmful to crops. The condition seems to be improving where the land is irrigated, but where it lies idle the salt concentration is probably slowly increasing.

SUMMARY

The Minidoka area is in the central part of southern Idaho and includes parts of Minidoka, Cassia, Jerome, and Blaine Counties. It comprises 551 square miles, or 352,640 acres.

The area consists mainly of flat and slightly rolling plains, but the elevation increases toward the foothills on the southeast. The elevation ranges from 4,180 feet at the river level above Milner to more than 5,000 feet in the foothills of Goose Creek Mountains.

Snake River and its tributaries drain the area.

The only settlers in the area prior to the opening of the Government reclamation project in 1905 were on a few scattered cattle ranches and in the railroad town of Minidoka. After that date, settlement was rapid. About 55 per cent of the population live on farms, and the city population depends largely on the farms of the region for their food supplies. The lands are operated largely by the owners.

Good railroad facilities are accessible and good highways serve most of the area.

Burley and Rupert are the principal towns, and there are a number of smaller towns and shipping points.

The climate is fairly uniform throughout the area. The mean annual temperature at Rupert is 47.2° F. The maximum recorded summer temperature is 102° and the minimum recorded winter temperature is −24°. The average annual precipitation is 11.86 inches. The average date of the last killing frost in the spring is May 15, and of the earliest in the fall is September 18. Prevailing winds are from the west and southwest.

Alfalfa, potatoes, wheat, and sugar beets are the most important crops. Considerable feeding of cattle and sheep and some dairying are carried on. Potatoes, wheat, flour, sugar, and livestock are shipped to distant markets.

The larger part of the cultivated land is included in the irrigated area. A small acreage is dry farmed, but with indifferent success. A large additional acreage of land will be brought under irrigation upon the completion of the proposed irrigation projects.

Twenty-two types of soil, including several phases, have been mapped, together with three classes of miscellaneous land. The soil materials include loessial, old stream-laid, old alluvial-fan, and recent-alluvial deposits. Almost all the soils vary in color from light brown to brown.

The Portneuf soils, which cover nearly one-half of the area, are loessial and are highly calcareous, Portneuf silt loam being the most extensive soil. Although this soil is a very productive soil in the adjoining Twin Falls area, little of it in this area is under cultivation. Much of it lies within proposed irrigation projects.

The Minidoka soils also are extensive. They are similar in origin and surface appearance to the Portneuf soils, but the subsoil is more thoroughly cemented by lime. A true hardpan occurs in most places.

The Winchester soils are not extensive; they occur mainly on narrow, wind-drifted ridges. Very little of the land is under cultivation on account of the unfavorable surface features and the loose, droughty character of the soil.

The Declo soils have stratified, water-laid subsoil and gravel substrata materials. Practically all these soils are under cultivation. Alfalfa, potatoes, sugar beets, and wheat are the principal crops grown. Paul, Rupert, and Ephrata soils are under cultivation, and grow the same crops.

In some places in areas of Onyx soils drainage is somewhat restricted, but the land is productive, though it is of small extent and of comparatively little agricultural importance.

The Snake soils are distinctly calcareous, the drainage is poor, and the soil is impregnated with alkali salts. These soils are used chiefly for pasture.

The Goose Creek soils occur principally along Goose and Marsh Creeks. Much of this land is under cultivation. They are very productive, producing large yields of alfalfa, potatoes, wheat, and sugar beets, as well as a number of other crops.

The miscellaneous lands are mainly nonagricultural and are grouped into three classes, scabland, rough broken and stony land, and rough mountainous land.

Irrigation is essential to continued successful crop production. Most of the irrigated lands are included in the Minidoka Reclamation Project. Under these units, a total of about 100,000 acres were devoted to irrigated crops in 1923. Small additional areas are irrigated under other included or partly included irrigation projects.

The soils of the area vary widely in permeability, water-holding capacity, and drainage. It is estimated that 1,000 acres under the Minidoka project were damaged by seepage in 1923, and 30,000 acres are protected by drains.

Injurious accumulations of alkali salts are confined mainly to inextensive areas of low bottom lands, and alkali concentrations do not seem to have been seriously increased by extensive irrigation.

Areas surveyed in Idaho, shown by shading

Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The USDA Target Center can convert USDA information and documents into alternative formats, including Braille, large print, video description, diskette, and audiotape. For more information, visit the TARGET Center's Web site (http://www.targetcenter.dm.usda.gov/) or call (202) 720-2600 (Voice/TTY).

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to

U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).