# SOIL SURVEY OF THE WALLA WALLA AREA, WASHINGTON.

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## LOCATION AND BOUNDARIES OF THE AREA.

The area surveyed occupies the south central part of Wallawalla County, Wash. This county is in the southeastern part of the State and is bounded on the east by Columbia County, on the south by Umatilla County, Oreg., on the west by Klickitat, Yakima, and Franklin counties, Wash., and on the north by Franklin County, Wash. An

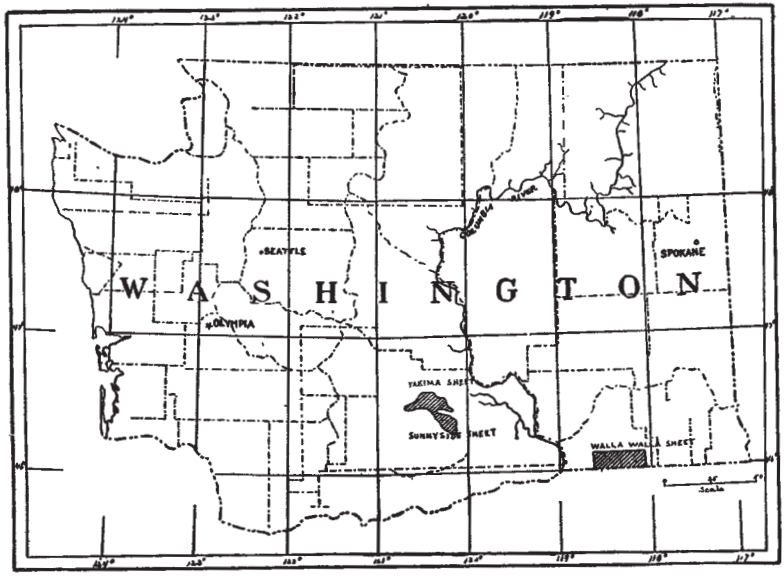


FIG. 22.—Sketch map showing areas surveyed in Washington.

area 8½ miles north and south by 24 miles east and west was mapped. The area comprises a part of townships 6 north and all of townships 7 north, in ranges 34, 35, 36, and 37 east. This area contains the city of Walla Walla, and includes all the lands under cultivation devoted to the growing of fruit and vegetables in that vicinity, and a representative part of the wheat lands of Wallawalla County. The eastern end of the area includes a part of the compact foothill lands west of Blue Mountains, while in the western end occur the fine sandy hill lands which border the Columbia River. (See fig. 22.)

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Prior to 1836 there was no attempt whatever to grow crops of any kind in this region. A few trading posts of the Hudson Bay Company were then the only settlements of white men in this northwestern territory. In that year, however, came the usual forerunner of civilization in the West, the Indian missionary. Dr. Whitman, with a small band of missionaries, settled on the Walla Walla River about 7 miles west of where the city of Walla Walla now stands. Garden truck and fruit trees were planted in a small way. The hostility of the Indians and lack of markets, however, prevented any real agricultural development until several years later. In 1853 the Territory of Washington was set aside, including the present States of Washington, Idaho, and the part of Wyoming and Montana west of the Rocky Mountains. The garrison at Walla Walla was established in 1856. In 1857 a small garden was planted at the garrison, which did remarkably well. The following year an experiment was made in growing barley—80 acres, which yielded 50 bushels per acre, being planted in the vicinity of the present fort.

This success encouraged the few squatters near the garrison and finally led to a treaty being made with the Indians (1859), whereby the region, including Walla Walla, was thrown open for settlement. Only a small amount of grain was grown this year, however, as the garrison afforded the only market, but it was demonstrated that grain could be grown in amazing quantities, so that quite a number of settlers came in and took up land in the valleys along the small streams.

In 1860 occurred what has always been the greatest factor in the settlement of our frontier—the discovery of gold. A party of prospectors brought out a small amount of gold dust from the North Fork of the Clearwater in the Palouse country. This discovery caused a mad rush of gold seekers—all of whom bought their supplies at Walla Walla—to the new region, and a ready home market was created for all farm produce. The small valleys, which were then considered the only land of agricultural value, were rapidly settled and farmed to grain and hay. By 1867 the rush to the mines had somewhat subsided, the quantity of grain grown had increased, and farm products were grown in the vicinity of the mines, so that the farmers of Walla Walla were again seeking a market. This year a small shipment of wheat and flour was made by teams to Wallula, on the Columbia River, and by steamboat from there to tide water. The receipts from these shipments were very satisfactory, notwithstanding the high freight rate from Walla Walla to Wallula. About this time began the agitation for a railroad from Walla Walla to Wallula. A company was formed and surveys made, but nothing was actually done upon the building of the road until 1874, when it was built from Wallula as

far as Touchet. The following year it was completed to Walla Walla. Although this road was a primitive, narrow-gauge affair, it hauled hundreds of tons of wheat to Wallula each year. From this time on the growth of agriculture in the valley has been gradual and substantial. Soon it was found that the hills grew fully as good grain as the small valleys, and that these valleys were well adapted to the growth of alfalfa, garden vegetables, and fruit. In a short time the road connecting Walla Walla and Wallula was absorbed by the Oregon Railway and Navigation Company and converted into a standard-gauge road. This completed the road to tide water, lessening greatly the cost of shipment. As transportation facilities increased and improved machinery lessened the cost of production the land cultivated to grain has gradually encroached on the hill land formerly devoted exclusively to grazing, until at the present time almost all the land in Wallawalla County, except some of the steepest hills and the sandy land in the western part, is now sown to grain. No more than five years ago all of the land in the northwestern part of the area mapped was open range, but the homesteader has now brought all this under fence, and although some of the slopes are very precipitous it is all farmed to grain.

In the last few years small fruits, vegetables, and berries have been the principal crops of many of the small farmers in the small valleys near Walla Walla. During last year shipments of such produce amounted on an average to about two carloads a day.

## CLIMATE.

Southeastern Washington is a semiarid, temperate region. The mean annual temperature of Walla Walla is 53° F. The recorded extremes are 113° F. above zero on August 10, 1898, and 29° F. below zero in January, 1875. The latter record was made before Walla Walla had a regular Weather Bureau station, and may not be correct.

The normal annual rainfall is 17.7 inches, which is a little more than that of the wheat regions of the San Joaquin Valley, California. Walla Walla is about the center of the area mapped, and the records may be taken as representing average conditions. Near the mountains on the east the rainfall is greater, and in the western end of the area, 2 miles west of Walla Walla, it is considerably less. Although no records have been kept in these places, the difference is evident in the yields of grain. A total failure of crops on account of drought, in the valley, has never been reported. The early records of the county show that in 1869 there was a drought, but even then there was half a crop grown. The lowest annual rainfall recorded is 11.80 inches, which occurred in 1890; the greatest was in 1885, when 22.27 inches fell. Appended is a table showing the normal monthly and annual

temperature and precipitation for Walla Walla. No other stations are maintained by the Weather Bureau in the area.

*Normal monthly and annual temperature and precipitation.*

| Month. | Walla Walla. | | Month. | Walla Walla. | |
|---|---|---|---|---|---|
| | Temperature. | Precipitation. | | Temperature. | Precipitation. |
| | ° F. | *Inches.* | | ° F. | *Inches.* |
| January | 31.9 | 2.30 | August | 73.2 | .41 |
| February | 37.9 | 1.53 | September | 62.6 | .90 |
| March | 45.4 | 1.82 | October | 52.8 | 1.52 |
| April | 53.2 | 1.79 | November | 42.6 | 2.07 |
| May | 60.4 | 1.66 | December | 37.1 | 2.17 |
| June | 65.7 | 1.27 | Year | 53.1 | 17.74 |
| July | 74.3 | .30 | | | |

A good percentage of the winter precipitation is in the form of snow, enough of which falls to afford sleighing for at least a part of each winter. Hot winds sometimes visit the valley in June and injure the wheat in its later stages, and occasionally winter freezes are severe enough to kill fall-sown wheat. These occurrences, however, are the exception, and the climate on the whole is excellent for the production of the cereals.

## PHYSIOGRAPHY AND GEOLOGY.

What is usually known as the Walla Walla Valley is one great expanse of rolling hills. In no place is there any considerable area of level land, except immediately along the small streams, which in some instances have cut out level valleys a mile or so in width. Immediately south of Walla Walla and also to the northeast of the city these hills are gently rolling, affording fields that are easily cultivated, but the foothill land in the eastern part of the area and the country in the western and northern parts is composed of very high, steep hills, which in many places are very difficult to cultivate. The small valleys are sufficiently level to readily allow irrigation. Although the country is very broken and hilly at the present time it was once the comparatively level bottom of the ancient Lake John Day, which at one time covered what is now northeastern Oregon, southeastern Washington, and western Idaho. Subsequent elevation and folding of the rocks lying in the lake bottom, due to volcanic agencies, have given to the country its present physiographic features.

Mill Creek, one of the principal streams of the area, rises in the Blue Mountains in Oregon, southeast of the area, and enters Washington in the southeastern corner of the fractional T. 6 N., R. 37 E., and flows in a northwesterly and westerly direction until it empties into the Walla Walla River in T. 7 N., R. 35 E. It is this stream

which flows through the city of Walla Walla and furnishes water for the city and for the greater part of the present irrigation.

About 5 miles east of Walla Walla two streams, called, respectively, Garrison and Yellow Hawk creeks, leave Mill Creek. South of these Russell, Clark, and Cottonwood creeks flow in a general northwesterly direction to the Walla Walla River, in T. 7 N., R, 35 E. All these smaller creeks are fed by springs, some of which flow large quantities of water. Walla Walla River enters the area from the south, in T. 6 N., R. 35 E., and flows northwest until joined by Mill Creek, after which the course is nearly due west to the Columbia River, 35 miles west of Walla Walla. South and west of the Walla Walla the Little Walla Walla River and Mud Creek enter from Oregon and flow northwest into the Walla Walla. Dry Creek rises in the northeastern part of the area, flows north to several miles north of the district surveyed, and again enters the area in T. 7 N., R. 35 E., from which point it flows southwest to the Walla Walla River. All of these streams contain water the year round, not all of which is at present utilized.

All of that part of the area south of Dry Creek is underlain by water-bearing gravels at a depth of from 20 feet in the valleys to 100 feet in the hill lands. North of Dry Creek a solid mass or sheet of basalt is encountered at about the same depth as the gravel beds south of this stream. No water has yet been procured in this northern region.

The whole area and the regions beyond give evidence of succeeding periods of volcanic activity. The gravel in the stream beds and that dug from wells throughout the valley is all of volcanic rock. The impervious layer of rock encountered north of Dry Creek is an old lava flow. West of the area, toward the Columbia River, are found lava flows of much more recent date, and volcanic ash, deposited along with products of erosion, forms a noticeable percentage of all of the soils.

Granite bowlders, often weighing a ton, are found scattered erratically over the area, sometimes on the top of the hills and again along the sides of the hills. Some are entirely buried, while others outcrop, but all are angular and only slightly weathered. The nearest granite mountains are miles away, so that these bowlders must have been brought into the area by icebergs when the country was covered by water. Many of the bowlders are covered with a lime deposit, showing that they remained a long time under water.

## SOILS.

The soils of the area mapped are remarkably uniform. The soil mantle of the whole county was deposited at the bottom of a great lake, and at the time of deposit the soil material was virtually the same throughout. Variation in rainfall and erosion are responsible for the present differences.

Five types of soil were recognized and mapped, the extent and relative importance of which are shown in the following table:

*Areas of different soils.*

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---|---|---|---|---|---|
| Yakima sandy loam | 64,896 | 50.55 | Yakima gravelly loam | 10,048 | 7.83 |
| Yakima fine sandy loam | 26,688 | 20.79 | Yakima loam | 3,392 | 2.64 |
| Walla Walla loam | 23,360 | 18.19 | Total | 128,384 | |

YAKIMA SANDY LOAM.

The Yakima sandy loam is a friable grayish-brown sandy loam 6 feet or more in depth. The sand in the soil is very fine, with little clay, giving to the soil a characteristic ashy appearance. Occasional bands or pockets of volcanic ash and fine sand occur throughout the surface 6 feet. It is easily cultivated and retains moisture well. In some places a compact layer, at from 2 to 6 feet below the surface, somewhat resembles a hardpan. This layer is very soft and boggy after a season of rain, but as it dries out it gradually becomes harder until it is almost as hard as a calcareous hardpan. Examination shows it to contain a small quantity of alkali, which is no doubt the cause of the compactness of the soil. This hardpan, however, does not affect any considerable area, for in most cases where it does occur it is not near enough the surface to influence the crops grown.

The Yakima sandy loam occupies all of the hill area and the most of the area in the small valleys around Walla Walla, and reaches north and south to the limits of the survey. It represents a zone extending at a distance around the base of the Blue Mountains. The difference in texture between this soil and the fine sandy loam on the west and the more compact loam to the eastward is mainly the result of the difference in rainfall of the three regions. Toward the east, at the base of the Blue Mountains, the rainfall is much greater and weathering has been greater than at Walla Walla, and consequently a greater percentage of the sand has been converted to clay and here is found a compact sandy loam. To the westward the rainfall is much less than at Walla Walla, so that the original lake sediments are very little altered. Since the rainfall diminishes gradually as the distance from the mountains increases, these three soils gradually blend into each other, making the boundaries zones rather than well-defined lines of contact, as is often the case in alluvial soils.

The greater part of the Yakima sandy loam occurs as steep, rolling hills. In the immediate neighborhood of Walla Walla, however, to the south, east, and northeast, these hills are only slightly rolling and not difficult to cultivate, but farther north and west, and next the Walla Walla loam on the east, the hills are very steep. In many places the

narrow valleys along the streams are of this same soil, which has merely been leveled down and shifted about from one side of the valley to the other by the stream as it has worn its way through the hills.

Owing to the prevailing hilly surface and the open, porous texture of the soil, the greater part of this type is well drained. A few small areas along the streams would be benefited by drainage, but these are very limited in extent.

As originally deposited in the lake bottom this soil came principally as the product of erosion from the surrounding high mountainous region. Mixed with this was a considerable quantity of volcanic ash.

Nearly all of this soil contains a small quantity of alkali. In most places this is not enough to affect crops, but in the areas along the streams, where the ground water has stood near enough to the surface to allow evaporation to take place continually, the alkali has accumulated in sufficient quantity to materially injure crops. Compared with the total acreage, however, the percentage of alkali soils is very slight.

Nearly all the Yakima sandy loam is sown to wheat or barley, which are the main crops of the country. Wheat is grown most extensively and yields an average of about 30 bushels per acre, while barley produces an average of 40 bushels per acre. Alfalfa is grown in places along the streams and yields well, but this soil may be said to be especially adapted to wheat and barley.

The following table gives mechanical analyses of the soil and subsoil of this type:

*Mechanical analyses of Yakima sandy loam.*

| No. | Locality. | Description. | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6683 | No. 12-40, sec. 8, T. 7 N., R. 35 E. | Sandy loam, 0 to 48 inches. | 0.91 | Tr. | 0.10 | 0.14 | 3.88 | 44.24 | 46.28 | 4.38 |
| 6684 | No. 6-40, sec. 25, T. 7 N., R. 35 E. | Sandy loam, 0 to 54 inches. | .88 | 0.10 | .16 | .34 | 2.68 | 39.60 | 52.08 | 4.60 |
| 6867 | No. 15-40, sec. 34, T. 8 N., R. 35 E. | Sandy loam, 0 to 72 inches. | .82 | .22 | .64 | .72 | 4.20 | 17.22 | 70.72 | 6.20 |
| 6865 | NE. corner sec. 18, T. 7 N., R. 37 E. | Sandy loam, 0 to 40 inches. | 2.21 | .04 | .16 | .18 | 3.06 | 17.26 | 70.62 | 8.68 |
| 6863 | NW. corner sec. 16, T. 7 N., R. 37 E. | .....do..... | 2.16 | .08 | .42 | .26 | 2.40 | 18.68 | 69.04 | 9.04 |
| 6864 | Subsoil of 6863..... | Sandy loam, 40 to 72 inches. | .74 | .10 | .34 | .16 | 1.94 | 18.88 | 70.62 | 7.96 |
| 6866 | Subsoil of 6865..... | .....do..... | .64 | .02 | .08 | .10 | 1.58 | 12.22 | 76.88 | 9.00 |

WALLA WALLA LOAM.

The Walla Walla loam is a compact, sticky brown to dark-brown loam, inclined toward a sandy loam, 3 feet in depth, underlain by a sandy loam similar in texture to the subsoil of the Yakima sandy loam. The roads of this district are hard and the fields often bake and plow up in great clods.

As has been before stated, this soil is found occupying the higher hill region in the eastern part of the area. The hills here are very high and steep, merging gradually into the Blue Mountains. The same soil extends an undetermined distance eastward. The steep slopes afford good drainage, so that even in the rainy seasons the soils are well drained.

This soil was formed in the same way as the Yakima sandy loam, the present difference being due mainly to their geographical position in respect to the mountains.

No part of this soil contains harmful amounts of alkali salts. This is due to the greater rainfall and absence of low, level stretches where the alkali might accumulate.

Like the Yakima sandy loam, the Walla Walla loam is sown almost exclusively to grain, of which it produces more than the first-mentioned soil, averaging about 35 bushels of wheat and 50 bushels of barley per acre. This increased production is due partly to the greater rainfall and partly to the heavier nature of the soil. It is the best grain land in the area.

The following table gives mechanical analyses of soil and subsoil of this type:

*Mechanical analyses of Walla Walla loam.*

| No. | Locality. | Description. | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6852 | SW. corner sec. 23, T. 7 N., R. 37 E. | Compact sandy loam, 0 to 40 inches. | 3.68 | 0.30 | 0.36 | 0.42 | 3.80 | 14.40 | 69.10 | 11.28 |
| 6856 | SW. corner sec. 3, T. 6 N., R. 37 E. | Sandy loam, 0 to 30 inches. | 1.96 | .62 | .92 | .38 | 1.82 | 11.48 | 70.98 | 13.60 |
| 6854 | SE. corner sec. 27, T. 7 N., R. 37 E. | Compact sandy loam, 0 to 50 inches. | 4.27 | .40 | .44 | .26 | 1.94 | 12.14 | 68.40 | 16.26 |
| 6853 | Subsoil of 6852..... | Sandy loam, 40 to 72 inches. | 2.24 | .18 | 2.90 | .30 | 4.64 | 25.70 | 61.20 | 4.80 |
| 6855 | Subsoil of 6854..... | Compact sandy loam, 50 to 72 inches. | .91 | .40 | .70 | .36 | 2.00 | 13.00 | 71.72 | 11.72 |
| 6857 | Subsoil of 6856..... | Sandy loam, 30 to 72 inches. | .68 | .88 | 1.52 | .78 | 2.54 | 12.24 | 66.38 | 14.08 |

YAKIMA FINE SANDY LOAM.

This is a whitish to gray fine to very fine sand, having the properties of a sandy loam. It is locally known as "light land," as when it is plowed it is very loose and ashy. In most places the soil is 6 feet or more in depth, but occasionally small areas are underlain at a depth of 3 feet by a sort of hardpan, which marks the average penetration of the rain water.

This soil is found wholly in the western part of the area and extends across the hills and valleys, as the Yakima sandy loam does to the eastward. The hill land is well drained, but a part of the area along the Walla Walla River needs drainage. Like the soils already described, it is derived from sediments of the ancient Lake John Day, with admixtures of volcanic ash.

The hill lands all contain a small percentage of alkali, but there is not enough seepage there to concentrate this in harmful quantities in any locality. Along the river, however, the greater part of the Yakima fine sandy loam is alkaline and is at present used only as pasture.

Nearly all the hill lands are now sown to wheat, but the soil produces less than the lands farther east. Twenty bushels of wheat per acre is a fair average for this section, while barley usually produces about 30 bushels per acre. Lightness of the soil and decreased rainfall are the causes of this lessened yield.

The following table gives mechanical analyses of soil and subsoil of this type:

*Mechanical analyses of Yakima fine sandy loam.*

| No. | Locality. | Description. | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6859 | W. side No. 12–40 sec. 15, T. 7 N., R. 34 E. | Fine sandy loam, 0 to 60 inches. | 0.97 | 0.08 | 0.34 | 0.36 | 4.60 | 19.08 | 69.80 | 5.72 |
| 6862 | Center sec. 31, T. 7 N., R. 34 E. | .....do..... | .38 | .02 | 1.14 | .78 | 5.80 | 27.56 | 58.06 | 6.46 |
| 6860 | SE. corner No. 8–40 sec. 29, T. 7 N., R. 34 E. | .....do..... | .89 | .04 | .38 | .54 | 3.98 | 9.46 | 77.86 | 6.96 |
| 6858 | NE. corner No. 14–40 sec. 34, T. 7 N., R. 34 E. | Fine sandy loam, 0 to 36 inches. | .84 | 1.10 | 3.58 | 2.36 | 8.00 | 14.06 | 60.96 | 9.46 |
| 6861 | NE. corner No. 10–40 sec. 16, T. 7 N., R. 34 E. | Fine sandy loam, 0 to 60 inches. | .33 | .24 | .92 | .80 | 3.60 | 8.46 | 68.58 | 16.22 |

YAKIMA LOAM.

The soil of the Yakima loam consists of a dark-brown to black friable loam 3 feet deep, underlain by a sandy loam or gravelly loam. It is found only along the small streams of the area, where it exists in small level areas. It is usually sufficiently well drained to allow the growth of vegetables, small fruits, or alfalfa, although in a few places the water comes within 4 feet of the surface. It has been formed in parts of the valleys subject to overflow and is the finer sediment from the streams mixed with organic matter from decaying vegetation.

Very little of the soil is alkaline, the only place being along Dry Creek, in the northwestern part of the area.

The Yakima loam is nearly all planted to vegetables, small fruits, and alfalfa, producing fair crops of all. It may be said to be best adapted to these crops.

The following table gives mechanical analyses of soil and subsoil of this type:

*Mechanical analyses of Yakima loam.*

| No. | Locality. | Description. | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6686 | Center sec. 28, T. 7 N., R. 36 E. | Black, sticky loam, 0 to 36 inches. | 3.37 | 0.50 | 1.12 | 1.32 | 8.10 | 23.38 | 55.62 | 10.22 |
| 6687 | Subsoil of 6686..... | Yellow sandy loam, 36 to 72 inches. | .53 | 6.64 | 5.20 | 1.86 | 3.40 | 18.90 | 46.90 | 17.06 |

YAKIMA GRAVELLY LOAM.

The Yakima gravelly loam is a brown loam with a depth of 3 feet, containing a high percentage of rounded, waterworn basalt gravel, ranging from one-third of an inch in diameter to the size of a man's head. Below the surface 3 feet the percentage of gravel increases and the soil is closely cemented together.

This soil is found only in the level valley portions of the area and skirting the streams, the largest areas being in the immediate vicinity of Walla Walla. The surface is comparatively level, being broken only by small stream beds. It is always well drained.

The soil is the direct result of the streams along which it occurs. Erosion has worn away the sandy-loam soil that covers this portion of the valley, exposing the gravel beneath. This has received a small amount of sediment from the streams and thus becomes a gravelly loam. None of this soil contains harmful amounts of alkali.

Only about 30 per cent of the soil is cultivated. It is planted to vegetables and small fruits that require irrigation. These crops yield well. The remainder of the soil, usually along the streams, is used for pasture land. Where the percentage of gravel is not so great as to make cultivation impracticable the gravelly loam, with the aid of irrigation, is well adapted to vegetable and small-fruit growing.

The following table gives a mechanical analysis of this soil:

*Mechanical analysis of Yakima gravelly loam.*

[Fine earth.]

| No. | Locality. | Description. | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 6685 | NW. corner No. 11–40, sec. 19, T. 7 N., R. 36 E. | Gravelly loam, 0 to 12 inches. | 1.50 | 3.12 | 6.26 | 3.92 | 11.50 | 21.70 | 44.34 | 7.88 |

## IRRIGATION.

Irrigation in the vicinity of Walla Walla is confined to the small valleys, as the hills are too rough to permit of any practicable method of applying water. Even of the valley land but a small percentage of that nearest Walla Walla is irrigated. This is planted principally to truck and fruits. Alfalfa, which is grown extensively upon the bottom lands, is not generally irrigated, although a few farmers have begun to irrigate this crop, with fair results in increased yields.

There are in all about 2,500 acres of irrigated land. The water for this irrigation is taken from the creeks in very small ditches, which are owned by the irrigators individually. In places where only small plots are to be irrigated water wheels are used to lift the water onto the land.

With a careful distribution of the water the irrigated area along the creeks could be increased about one-half. Farther west in the area, along Walla Walla River, much water runs to waste that might be used for irrigation. In that place there are several small ditches, but these are out of repair and little used. Much of the soil there is alkaline, the reclamation of which would be greatly facilitated by the liberal application of irrigation water, and would be assured if this was supplemented with thorough drainage.

Altogether there are fully 5,000 acres of land within the area mapped that could be economically irrigated.

ALKALI IN SOILS.

Toward the western part of the area, along the Walla Walla River and Mud and Dry creeks, the land is alkaline, some of it so much so as to be practically abandoned. Even in the small valleys about Walla Walla and in some places on hillsides small patches of alkali are seen, but these patches are limited in extent, and the percentage of alkali present in the soil is very low. The nearest alkali in sufficient quantity to be mapped is about 3 miles west of Walla Walla, in sec. 27, T. 7 N., R. 35 E. West and south from this point small areas of alkali are found along the streams.

All the soil of the valley has traces of alkali, and these areas, when the amount is harmful, are caused by the localizing and concentration of the alkali by the water, which takes up a small amount of salt only to deposit it at the point of evaporation. Thus an accumulation of alkali is the usual accompaniment of a high water table. Small alkali patches at the base of hills are caused by the seepage from rain water which soaks into the hills, dissolves the easily soluble alkali salts, and then in part slowly seeps out and is evaporated, leaving the alkali on or near the surface.

The alkali of the Walla Walla Valley is nearly all carbonate and bicarbonate of sodium. This is what is known as "black alkali," the most harmful salt found in the soil. One-tenth of 1 per cent of this alkali is sufficient to kill any of the useful plants grown in this region. While the total salts in the surface 6 feet rarely exceeds 0.20 per cent, there is quite an area in the western part of the district, along the Walla Walla River, that for the surface 3 feet contains more than 0.20 per cent of black alkali alone. The less harmful salts that are usually found in connection with the black alkali are here almost wholly absent.

Accompanying this report is a black-alkali map (Pl. XLII). This map shows the percentage of sodium carbonate in the surface 3 feet, this depth being selected because it is in the surface 3 feet that most of the alkali is found. In a few instances quite high percentages were found below the third foot, but these cases were rare. It is the usual custom to construct a total-salts map which, when the total salts compose 0.20 or more per cent of the surface 6 feet, shows the location and extent of such areas, but, since in this region the alkali is nearly all black and contained in the soil near the surface, this total-salts map was not constructed.

The black-alkali map shows four grades of soil—that containing less than 0.05 per cent black alkali, from 0.05 to 0.10, from 0.10 to 0.20, and that which contains more than 0.20 per cent. The soil which contains less than 0.05 per cent includes all the hill land and the greater part of the small valleys. Only a small part of the area sur-

veyed contains enough alkali to be impaired for agricultural use. Five one-hundredths per cent in the soil from which the plants feed is enough to materially injure susceptible crops, like wheat or many of the vegetables. Barley will do fairly well on such land, and alfalfa if once well established will grow, though it will not thrive. Pears and apples are affected, but will live. As this amount is increased, however, the list of plants that may be grown rapidly diminishes until, when the concentration reaches 0.10 per cent, none of the crops of the valley will grow. All land which contains from 0.05 to 0.10 per cent requires careful cropping to produce anything at all, and must be cleansed of at least part of its alkali before it can be profitably farmed. All land containing more than 0.10 per cent must be reclaimed before crops can be grown.

### RECLAMATION OF ALKALI SOILS.

There is no alkali land in the area mapped that can not be economically reclaimed. It is all situated in the small valleys along the streams, and when under cultivation and free from alkali is the most valuable soil in the Walla Walla country. The soils are all of such an open and porous nature that alkali may be readily washed from them, and the numerous small streams that intersect the area are usually far enough below the level of the valleys to afford good outlets for drains. These same streams afford ample and excellent water for irrigating all the land that is contained in the valleys. The present condition of the alkali areas is due either to neglect or to improper methods of cultivation. The most efficient way in which the land can be reclaimed is to remove the alkali in the way that it was accumulated—that is, through the action of water. If the land were continuously cultivated, or a mulch maintained in some other way, as by the application of straw or manure, the rainfall would in the course of a few years reclaim the areas that are now only partially injured. But since water for irrigation can be obtained so readily and so cheaply the rainfall should be augmented by irrigation.

In preparing the land for reclamation the greatest care should be exercised in getting it in such a condition that when water is applied all parts of the land will be covered. If high spots are left, the effect will be to concentrate the alkali in such spots. After the land is perfectly leveled it should be heavily flooded as often as possible, and if after this treatment the soil is still too strongly impregnated with the noxious salts to allow the cultivation of some crop, then as soon as dry enough the soil should be stirred to prevent evaporation and a return of the alkali to the surface. If this heavy flooding is done in the fall or winter, when the ground is not frozen, it will be more effective than if done in summer, for the evaporation is much less. As soon as enough alkali is washed out of the soil a crop should be seeded. Barley is one of the best crops to use in the reclamation, for it not only

withstands relatively high percentages of alkali, but also effectively shades the ground and prevents evaporation. When a crop or two of barley has been grown, a stand of alfalfa may be obtained, after which, with fair treatment, not too close pasturing, and an occasional flooding, no difficulty should be experienced. If the ground water in any part comes to within less than 4 feet of the surface, deep ditches should be cut for drains, or tiles put in to carry off the surplus water.

This reclamation, even when tiles are necessary, can be accomplished very cheaply. In no case will expensive outlets have to be dug for the drains. Twenty-five dollars per acre should be ample to cover the expense even for the worst lands, which now are practically worthless. These lands when reclaimed are worth from $80 to $100 per acre.

### AGRICULTURAL METHODS.

Contrary to Eastern and Middle Western practices, no rotation of crops is practiced in the Walla Walla area. Wheat and barley are grown continuously and almost exclusively, the only other crops being vegetables, fruit, and alfalfa grown along the streams. Of the staple cereals wheat has by far the larger acreage. Only enough barley is grown for home consumption. At first the same land was sown year after year to wheat, but this continual drain on its fertility, with no change or rest, soon began to have its effect in lessened yields. No crop has yet been introduced to rotate with the wheat, so that the common practice is to "rest" the land by summer fallowing it at least one year in three. The majority of farmers summer fallow alternate years, so that if a man has a 320-acre farm he will each year harvest 160 acres of grain.

Plowing for grain is done any time after the first heavy rains in the fall. This is done by plowing round and round the field with six or eight horse gang plows, the finishing of the "land" being at the center of the field. In the very hilly parts each hill is plowed around in this way until the field is finished. After being plowed the land may be harrowed, but it is usually left rough until late spring, when the weeds have begun to grow, when it is either harrowed, disked, or cultivated in some other manner to kill the weeds. An instrument now very much used for this purpose is what is called a "slicker." It consists of three parallel 5-foot sections of 2 by 6 scantling fastened together, like a "marker," with horizontal scantling 2 by 4 inches in dimension and 10 feet long. The front ends of the three parallel pieces are rounded to make them drag easily through the soil. Fastened to the lower rear end of these runners is a broad knife which extends the length of the "slicker." This knife passes a little beneath the surface and cuts off the weeds. Four horses are required to draw the implement, the driver riding upon it. Where the weeds are small this affords an excellent way of killing them, for the reason that it does

not expose any great amount of moist earth on the surface. Another machine has been devised which in foul land bids fair to be a great boon to the farmer. This is a double disk working upon the same principle as the ordinary farm disk, but so arranged that one row of disks follows another, cutting the small spaces between the disks and throwing the soil in the opposite direction from that of the first disk. In both of these methods of cultivation the main object is to kill the weeds, and the machine which does this most effectively and with the least amount of labor is the one most popular with the farmer. The number of cultivations summer-fallow land may receive depends upon the growth of weeds. As often as the weeds grow up the land is cultivated, but this is rarely more than three times during a season.

The practice in growing winter wheat is to seed in the fall as soon as the first heavy rains have fallen. This gives the wheat a chance to make a vigorous growth before winter sets in and to be ready to withstand the cold. Seed is still principally sown broadcast and then harrowed in. For this a very large harrow, consisting of many diamond-shaped sections, is used. Six or 8 or even 10 horses are employed, driven by a man on horseback. A few have begun to use the wheat drills in common use in the East and Middle West. They are considered a marked improvement over the old broadcast system. After the grain is sown no further care is necessary until harvest time.

The greater part of the harvesting is yet done with headers, the wheat being stacked pending the thrashing, which is usually done by perambulating thrashing machines. Harvesting begins about the 1st of July and soon after the thrashers begin their work and quickly convert the heaps of heads into straw and sacks of grain.

Quite a number of farmers are now using the combined harvesters, which cut, thrash, and sack the grain all at the same time. These machines so far seem to be a success and the present season (1902) several new ones began operations.

The effect of summer fallowing upon the crop has long been experimentally determined by the farmers of the Walla Walla Valley. The bare, exposed fields are kept continually warm by the sun, while the surface cultivation acts as a mulch to prevent the escape of moisture by evaporation. This prevention of the escape of moisture is very noticeable. Fields were examined late in July at harvest time that had been summer fallowed and were found to contain below the thin covering of mulch sufficient moisture for plant growth, while neighboring fields of wheat were very dry to a depth of several feet. Thus in regions of light rainfall much of the benefit of summer fallow is due to the combining of the rainfall of two years for the growing of one crop. In addition to the increased activity of the micro-organisms to produce available nitrogen, the general condition of the soil is

benefited by this complete exposure to the elements. General weathering is accelerated, breaking down the soil particles and setting free more rapidly than under ordinary conditions all the elements necessary for plant growth, so that while the old crop left the soil exhausted of moisture and impoverished in plant food, this year of rest has not really been one of rest at all, but a year of constant activity, making ready for the nourishment of the new crop.

The fruits grown in this area consist principally of prunes, apples, pears, and cherries, while a few other deciduous fruits are less extensively grown. Experience has shown that these fruits may be grown back in the hill lands without irrigation, but very few orchards are as yet planted outside the level, irrigated lands of the valleys. Most of the orchards are irrigated in furrows, the space between the trees being constantly cultivated and usually planted to some minor crop. The apple, pear, and prune require a great deal of labor and expense in spraying, the apple and pear being subject to attack by the codling moth and also together with the prune to damage by the San Jose scale. Cherries thrive and are less affected by pests.

The common practice is to plant truck or berries in the spaces between the trees in the orchards. These intermediary crops are irrigated from small furrows between the rows, the water being diverted from the streams in small ditches. No irrigation systems of any great extent are in operation.

All kinds of truck are grown. Potatoes, onions, cabbage, and asparagus, however, are the principal products. For early spring cabbage the plants are set out in the fall in rows 3 feet apart, with the plants 2 feet apart in the row. These plants withstand the freezes of winter. Potatoes and onions are also planted in the fall for early spring crops. Potatoes are planted in rows 3 feet apart and often reach maturity without irrigation. Onions are drilled in rows 12 inches apart and irrigated by making small furrows in alternate spaces between the rows. All the work after seeding onions must be done by hand, which makes their cultivation expensive. One man can attend to only about 1½ acres.

Strawberries and raspberries are irrigated and cultivated much the same as truck crops. The strawberries are planted in rows 3 feet apart and 18 inches apart in the row. Small ridges are thrown up and the plants set out on top of these ridges. Raspberries are set out 6 feet apart both ways.

## AGRICULTURAL CONDITIONS.

The Walla Walla Valley bears a marked air of prosperity. A failure in crops has never been known, and as new markets have been opened and transportation facilities increased the condition of the agricultural and dependent industries has steadily improved.

The farms are nearly all owned by the operators. The grain farms range in size from 160 acres to several hundred acres. In the vegetable and fruit growing district near Walla Walla the farms are divided into small tracts of from 10 to 20 acres, which are mainly rented to Chinese or Italian gardeners.

Grain farming does not require the attention of the farmer the entire year. There are two busy seasons, seedtime and harvest. Except for the necessary cultivation to kill weeds on the summer fallow no labor is necessary the remainder of the year. It is only during these busy seasons that the farmer needs to employ labor. Both seasons are short, so that responsible labor can not afford to come to the region for these short periods. The consequence is that a nondescript body of laborers come and go at these seasons. This labor is very unsatisfactory, but until the crops grown are such as to furnish labor for reliable men during the entire year little or no improvement in labor conditions can be expected.

Wheat is the principal crop. Hundreds of tons are produced each year, the greater part of which is exported either as grain or flour. Several varieties of wheat are grown, chief among which in order of importance are the blue stem, club, Salt Lake club, and red chaff. Blue stem is the variety most generally grown, since it is from this wheat that the best flour is made.

Enough barley is grown to supply home demands for feed and the local breweries. In the small valleys near Walla Walla excellent vegetables and berries are grown. These are handled by produce shippers, who buy the produce outright from the growers and ship it principally to points in the Dakotas, Montana, and British Columbia. As already mentioned, most of this truck is grown by Chinese and Italian gardeners, who rent the land in small tracts from the owners. This truck land is relatively very valuable, being worth from $100 to $150 per acre. Farther from town the valley lands are seeded almost exclusively to alfalfa. Three crops of hay are usually cut each year, and the fields also afford some pasture. The hay is principally sold to sheep and cattle men, who bring their stock down from the mountains to winter. The average price of alfalfa hay is about $4 per ton. A part of the wheat and barley is also cut for hay, and this usually sells for a little more than the alfalfa. In the western part of the area dairying has gained quite a foothold. Nearly all the farmers along the river have a few cows, the milk from which they sell to the creamery. Throughout the area the farmhouses are built wherever it is possible along the small streams, so as to be near water. South of Dry Creek, if no part of a stream is included on the farm, water may be had by digging shallow wells, but north of this creek no one has as yet been successful in finding water. A solid sheet of lava, which is very hard to drill and has never been penetrated, is encountered at

from 30 to 50 feet. Throughout this part of the area the procuring of water for stock upon the farms is a great problem. Cisterns are built and filled in winter, but these are usually empty before harvest time, and water has to be hauled from either the Touchet River or Dry Creek. The expense of hauling water through harvest is very great, as the roads are very hilly and only small loads can be hauled.

Walla Walla now has two railroads connecting the valley with the East and with the Pacific coast, so that there is no lack of transportation facilities. A narrow-gauge road also extends northeast from Walla Walla through the area mapped, tapping the rich wheat belt in that direction. Before these railroads were built and when there was only a narrow-gauge road to Wallula, wheat, being nonperishable, could be shipped, but the growing of vegetables and fruits was limited to home demand, and these industries owe their present importance entirely to the fast-freight system of the railroads. Although each field is small, this gardening, taken as a whole, adds not a little to the revenue of the valley. An average of about 2 carloads of garden produce is shipped daily, besides the amount consumed in Walla Walla.

The hauling of the wheat from the fields to the warehouses is the greatest item of expense in transportation. The country roads are, as a rule, very poor; only those roads that follow along the streams are in a fair condition. The others, which are made to follow section lines or other arbitrary divisions, go up hill and down, irrespective of contours. Some of the hills are very difficult to climb, and this makes the hauling of ordinary loads impossible, greatly increasing what would normally be the cost of hauling. The bettering of the roads by leveling would be an endless task and one involving great expense, and it is doubtful if much improvement will be made in this direction for many years to come.

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