SOIL SURVEY OF THE BELLINGHAM AREA, WASHINGTON.

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DESCRIPTION OF THE AREA.

The area surveyed comprises 245,696 acres, or about 384 square miles, of the northwestern part of Whatcom County, Wash., which is the extreme northwestern county of the United States. It is confined within parallels 49° 0′ 2″ and 48° 45′ north and meridians 122° 49′ 53″ and 122° 14′ 33″ west.

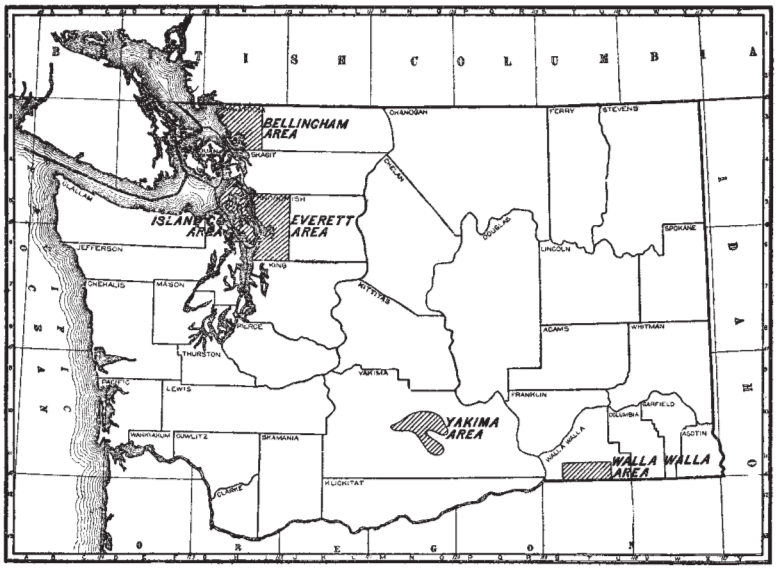

FIG. 36.—Sketch map showing location of the Bellingham area, Washington.

The area is bounded on the north by British Columbia, on the east by a north-and-south line passing about 1 mile east of Sumas, on the south by an east-and-west line through Bellingham, and on the west by the inlets and bays which form a part of Puget Sound.

The principal topographic features consist of the rolling uplands, which cover a large proportion of the entire district surveyed, the broad valleys of the Nooksack and Sumas rivers, the rough mountain-

ous region of the eastern and southeastern sections of the area, and the more or less extensive level areas, which represent the former basins of small lakes or shallow swampy depressions.

The upland consists of a series of ridges and rounded elevations, which vary in height from 50 to 300 feet above sea level. In many localities sharp rounded knolls, with intervening kettlelike depressions, occur, giving rise to the kame and kettle topography typical of glaciated regions. The hills and ridges are usually rounded and seldom steep enough to hinder cultivation. The valleys of the small streams draining the upland sections of the area are usually too narrow to permit the deposition of any alluvial material along their courses, and in many places where the topography is more hilly they occupy deep, canyonlike erosions, which have been cut down through the underlying glacial till to a depth of 40 to 75 feet. A large proportion of the central part of the area lies within a well-defined valley, which was probably formed by glacial action. The valley extends across the area from the eastern to the western boundary, but divides into two branches in the west-central part of the area, one of which follows a northwesterly course, reaching the Sound south of Blaine, while the other, which is occupied by the present channel of the Nooksack River, reaches the Sound at Bellingham Bay. Another branch of this valley crosses the northeastern part of the area and connects with the valley of the Fraser River a few miles beyond the limit of the survey.

The topography of this valley as a whole is gently rolling. The hills and ridges are low and rounded and slope gently toward the broad, shallow depressions, or comparatively level areas intervening. The streams which traverse this section of the area do not occupy deep, narrow channels, like those which traverse districts of a more rolling character, but flow through broad, comparatively level valleys, which are usually subject to overflow at times of high water.

The valleys of the Nooksack and Sumas rivers vary from 1 to about 3 miles in width. The surface is quite level, with a low ridge occurring often along the immediate borders of the stream, causing the land to have a gentle slope back from the present channels of the river. This sometimes results in the formation of small, poorly drained basins near the base of the more rolling area bordering the river valleys.

In the extreme northern part of the area there is an extensive plain or broad, shallow basin, locally known as the "Prairie." This region is almost entirely surrounded by rolling uplands and was formerly in a swampy, poorly drained condition. Other areas similar to this, but of much smaller extent, are found in many other sections of the area

surveyed. The surface of these shallow basins is almost level, but low, gentle swells, with broad, shallow depressions intervening, give them as a whole a very gently undulating topography.

The topography of the mountainous region is rough and broken. Some of the higher peaks rise to an elevation of 3,000 feet above sea level, and the intervening valleys are narrow and V-shaped. The hillsides are usually too steep for successful cultivation, and large areas of rock outcrop are frequently encountered on the more precipitous slopes.

The greater proportion of the area surveyed is drained by the Nooksack and Sumas rivers and their small tributaries. The Nooksack River enters the southeastern corner of the area and flows in a general northwesterly direction until it reaches the city of Lynden, in the north-central part, whence it turns in a general southwesterly direction and empties into Puget Sound at Bellingham Bay. Its principal tributaries within the area are Fishtrap and Bertrand creeks, which drain a large portion of the northern section, and Anderson and Ten Mile creeks, which aid in the drainage of the southern and central sections.

The Sumas River rises in the foothills of the mountainous region near the eastern boundary of the area, and flows in a general northerly direction, passing out of the area at its extreme northeastern corner. It finally empties into the Fraser River, at a point some distance across the Canadian boundary line. The principal tributary is Johnson Creek, which joins the river near the city of Sumas. The Dakota and California creeks drain a considerable proportion of the northwestern part of the survey. These two streams rise in the west-central part, follow a general northwesterly course, and empty into Puget Sound at Drayton Harbor, just south of Blaine. There are many other smaller streams draining limited areas, which empty directly into Puget Sound or into Lake Whatcom.

The greater number of the earlier settlers were attracted to this area on account of the great timber resources of this section of the State, but as the forests have been gradually cleared away, the agricultural population has steadily increased. A large percentage of the present population came from the north-central and middle-western States, but many also came from New York and other States along the Atlantic seaboard. There are many, also, who have come from British Columbia and other sections of Canada. Quite a number of Hollanders have come in during comparatively recent years, settling in the north-central part of the area, and there are also many Scandinavian farmers.

The area as a whole is very sparsely settled and a large part of it is still covered by a heavy growth of timber or is in the partially

cleared condition known as "logged off" land or "wild land." The "logged off" land is usually covered with a dense growth of underbrush and with the fallen trees, stumps, and "slashings" which remain after the merchantable timber has been removed.

The extensive level prairie north of Lynden is the most thickly settled part of the area, the reason being that this broad basin did not support a heavy growth of timber and could easily be cleared for agricultural purposes. In the rough, mountainous districts of the extreme eastern and southeastern parts of the area there are very few farms. The inhabitants of this region are mainly engaged in getting out the fir and cedar timber for the sawmills or shingle mills.

Bellingham, the county seat of Whatcom County, is the principal city within the area. It is located on Bellingham Bay in the extreme southern part of the area and has a population of about 30,000. Blaine, a town of about 3,000 inhabitants, is located on the coast of Puget Sound, in the extreme northwestern corner of the area. Sumas, another border town, with a population of about 1,200, is located on the Canadian boundary line in the extreme northeastern corner of the area. Lynden, Ferndale, Custer, and Everson, which are situated in the valley of the Nooksack River, are towns of 500 to 1,400 inhabitants.

The transportation facilities furnished by the railroads and steamship lines are exceptionally good. A division of the Great Northern Railway System, which extends from Seattle to Vancouver, British Columbia, traverses the western part of the area, passing through Bellingham, Ferndale, Custer, and Blaine. The Seattle, Everett and Vancouver division of the Northern Pacific Railroad passes through the eastern part of the area, connecting with the Canadian Railroad at Sumas. The Bellingham Bay and British Columbia Railroad traverses the area from Bellingham to Sumas, and a spur of this line extends from Hampton to Lynden. Stage lines, carrying both passengers and freight, make two trips daily between Bellingham and Lynden and Bellingham and Ferndale. The southeastern part of the area is traversed by another stage line, connecting Bellingham with Deming, which is located just east of the area surveyed. Steamships run regularly between Bellingham and all of the larger cities on Puget Sound, including those in both the United States and Canada. The harbor at Blaine also makes that town a shipping point of considerable importance.

Bellingham is the principal local market for all the products of the area. The surplus products are shipped to Seattle, which offers a ready market for all kinds of farm produce. The dairy products not sold at the local markets are handled by the creameries which have been established in almost all of the more important towns of the area. A large part of the output of the creameries goes to Seattle and

other larger outside markets. The surplus fruit was formerly marketed at Seattle, but the Fruit Growers' Association of Whatcom County has recently made arrangements to ship directly to the larger markets of the Middle Western States. There is usually a demand at the local markets for all the hay and grain produced in the area.

CLIMATE.

The nearness of the Japan Current, which here impinges upon the coast, and the sheltering influence of the lofty Cascade Range bordering the eastern edge of the area have so reduced the extremes in temperature for summer and winter as to give this region one of the most equable climates in the United States. The records of the Weather Bureau for the last nine years (1898 to 1906 inclusive), kept in Bellingham, show that the nine hottest days in that period had an average temperature of 85° F., while the nine coldest days averaged 12° F. above zero. The mean annual temperature for the same period was 50.2° F. The summers are characterized by cool nights and invigorating sea breezes during the day.

The atmosphere is decidedly humid, yet the mean annual precipitation is rarely more than 32 inches. The rain falls in gentle showers or precipitates in the form of fog or mist. The average annual snowfall ranges only from 0 to 10 inches and snow usually melts within a few hours. The greater part of the precipitation occurs during the period November to April, which is locally called the "rainy season." The greatest monthly precipitation is usually less than 6 inches. The records show that on an average 250 days of the year have neither rain nor snow.

The general effect of such climatic conditions is to produce a profuse growth of both native vegetation and cultivated crops. Oats give heavy yields, and timothy sometimes grows to a height of 7 feet with heads 7 to 12 inches long. The native vegetation is practically impenetrable, owing to its prodigious growth. The native forest trees are frequently from 5 to 15 feet in diameter and 150 to 200 feet in height. The climate is especially favorable to the growing of potatoes, small fruits, vegetables, apples, pears, plums, prunes, etc.

The equable climate, the distribution of rainfall, and absence of storms of any kind insure the farmers against annual crop failure, although the yields necessarily vary with the seasons. The growing season is long enough to harvest those crops for which the soils of this area are particularly adapted. The mild winters make it possible to pasture stock for the entire year and shelter is only necessary for a very limited time.

The following table gives the mean annual and maximum and minimum temperatures and precipitation, and condition of sky from 1898 to 1906, inclusive:

Year.	Length of record (years).	Temperature. °F.					Precipitation (inches).					Sky.			Prevailing direction of wind.
		Annual mean.	Highest.	Date.	Lowest above zero.	Date.	Total for year.	Greatest monthly.	Month.	Total snow (inches).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.	
1898..	4	50.0	84	Aug. 1	18	Jan. 25	28.40	4.08	Nov ..	6.0	133	143	125	97	SW.
1899..	5	49.7	96	July 28	3	Jan. 4	33.29	5.74	Nov ..	24.0	131	99	134	132	SE.
1900..	6	50.7	78	July 30	12	Nov. 21	34.73	4.40	Dec...	7.0	139	145	102	118	SE.
1901..	7	49.9	80	June 18	9	Jan. 9	31.99	5.91	Nov ..	15.3	120	133	137	95	SW.
1902..	8	49.9	94	Aug. 9	10	Jan. 25	31.27	5.98	Nov ..	9.3	113	123	143	99	SW.
1903..	9	49.5	86	June 8	19	Mar. 12	32.63	5.47	Nov ..	10.0	108	137	143	85	SW.
1904..	10	50.0	82	July 21	15	Feb. 9	29.88	5.75	Nov ..	13.5	87	154	102	110	SW.
1905..	11	50.3	81	Aug. 7	13	Feb. 10	27.59	6.82	Sept ..	0.0	87	167	121	77	W.
1906..	12	51.6	83	July 14	15	Mar. 15	33.72	5.43	Dec...	4.5	95	161	107	97	W.

Normal monthly and annual temperature and precipitation.

Month.	Bellingham.		Month.	Bellingham.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	Inches.		°F.	Inches.
January	39.4	3.17	August	60.9	1.11
February	42.3	3.10	September	55.9	1.96
March	44.1	2.61	October	51.0	2.16
April	48.6	2.61	November	43.9	5.00
May	53.6	2.57	December	42.2	4.61
June	58.2	2.15	Year	50.0	31.93
July	60.2	.88			

At Bellingham in 1906 the date of the last killing frost in spring was April 12, and of the first in fall October 20.

AGRICULTURE.

The area surveyed was first settled in 1852, but the population increased very slowly until about 1880, when the development of the great timber resources of the county began to attract settlers from the eastern States and from the older settled districts of the Northwest. After the advent of the railroads, about 1890, the development was more rapid, and large areas in the Nooksack and Sumas river valleys and Lynden Prairie, as well as smaller "logged off" areas on the uplands, were soon put under cultivation in order to supply the demand for farm produce created by the large lumber camps and rapidly growing towns which sprung up as a result of the lumber industry.

The valleys of the Nooksack and Sumas rivers and the broad, level prairie north of Lynden were first put under cultivation, and these sections of the area are at present more highly developed agriculturally than the rolling uplands. This is due to the fact that the river valleys did not support such a heavy growth of timber and could be cleared and put under cultivation at a comparatively small cost, and that the deep accumulations of organic matter and low, bushy growth, which covered the extensive poorly drained basin, known as "the prairie," could be easily burned off as soon as the land was thoroughly drained.

The difficulty of clearing the land of the stumps, fallen trees, and slashings, after the merchantable timber is removed, has greatly retarded agricultural development in the uplands, and the greater part is still in the condition locally known as "wild land." The old method of removing the stumps was quite expensive, and in many sections the cost of clearing land once covered by a heavy growth of timber averaged $80 to $150 an acre; but the more improved method now coming into general use, which consists of blowing up the stumps with powder or dynamite and pulling out the fragments by means of a donkey engine and wire cable, has reduced the cost of clearing land about one-half. When these uplands are once cleared and put under cultivation they are very productive, and farming has proved to be very profitable, even where the older and more expensive methods of clearing were used.

Lumbering is still the principal industry, and agriculture is at present only in the first stages of its development, but it is steadily growing in importance, and the area is rapidly becoming an agricultural section. The first crops grown were oats, hay, and potatoes, and these continue to be the staple products. During recent years, however, fruit growing has become one of the important industries, and the acreage planted in orchards is annually increasing.

Oats, hay, and Canadian field peas are principally grown in the river valleys or in the broad level areas which were once in a poorly drained condition. The better drained soils, both in the river valleys and small prairies, are well adapted to fruit, small fruits, and vegetables, and they often produce yields equal to those obtained in any other section of the area, but the comparatively small cost of clearing the lands has resulted in extensive methods of farming and has enabled the farmers in these localities to cultivate profitably such crops as oats, peas, and hay. In the uplands the farming is more intensive, with the principal crops fruits, small fruits, and Irish potatoes. Clover, timothy, and grain do exceedingly well on the upland soils; but as no large areas in the uplands have yet been cleared, the land is now devoted to those crops which are better adapted to intensive farming and give larger returns from a limited acreage.

The Canadian field pea is grown in many parts of the area. The crop is thrashed and yields about 40 to 50 bushels an acre. It is used mainly as feed for hogs, though a part of the crop is sold at the local markets for a good price.

The oats grown in the area are of excellent quality, and the large yield secured, together with the high prices obtained at the local markets, has made this a very profitable crop. On the soils best adapted to this crop 70 to 100 bushels are secured, though a yield of 125 bushels an acre is reported. Wheat also does well on many types of soil, but the climatic conditions are not favorable to the varieties thus far introduced in the area, the kernel being too soft for milling purposes. The small quantity of wheat produced is used mainly for chicken feed. Barley has been grown on a limited acreage, producing about 40 bushels an acre. A local brewery furnishes a ready market for this crop.

The Irish potato is one of the most important products of the area. The yields obtained range from 150 to 400 bushels an acre, and there is a fine local market for the crop at good prices. The potatoes grown are dry, mealy, and of good keeping quality and size. The principal varieties are the Early Rose, Late Rose, Burbank, Beauty of Hebron, and Champion of the World.

Clover and timothy do well on many types of soil, and from two to three cuttings can be obtained annually. Owing to the comparatively short season suitable for curing the hay, only one crop is cut, the land being used during the remainder of the time as pasture. The average yield of hay is about 3 tons an acre, and with the exception of that grown on the low, marshy areas, which usually contains a large amount of coarse native grasses, it is of good quality and brings high prices in the local market. The better quality of hay brought locally as much as $20 a ton during the season of 1907. A small acreage is in corn, but the varieties grown so far do not seem adapted to the climatic conditions and do not mature.

The principal varieties of apples now successfully grown for shipment to the larger markets are the King, Wagner, Gravenstein, Rhode Island Greening, Baldwin, Maiden Blush, Dutch Mignon, Wolf River (large), Gloria Mignon, and Alexander. The quality of this fruit is excellent. The King, Wagner, and Gravenstein are the favorite varieties, and seem to be well adapted to the soil and climatic conditions. Several varieties of cherries are grown, and the yields obtained are very good in quality and quantity. The Black Republican and Queen Anne seem to give the best results. Pears also do exceedingly well on many of the soil types, and very large yields are always obtained. The varieties which seem best adapted to the soils and climatic conditions are the Bartlett, Clapp's Favorite, Bennett, Clairgeau, Anjou, and Kieffer.

Some orchards of fall apples and pears have been set with local seedlings, but the best results have been obtained with trees from nurseries located in the State or in Oregon, where the climatic conditions are very similar to those found in this area. A few varieties have been introduced from abroad but with small success.

Both prunes and plums give large yields, but up to the present time there has been a poor market for these products. During the present season (1907), however, several shipments of prunes have been sent to the larger markets and have brought very fair prices. The Italian, Hungarian, Golden Drop, and Silver are the favorite varieties and all of these thrive. The Italian is the most popular.

Grapes are grown to a very limited extent. Very fair yields are secured. The varieties giving the best results are the Champion, Concord, and Niagara.

Vegetables, such as cabbage, carrots, squash, turnips, asparagus, sugar beets, garden peas, pumpkins, and cauliflower, are produced for the local markets. Celery of very fine quality is grown on some of the heavier organic soils, and rhubarb also does exceedingly well. Small fruits—blackberries, raspberries, and strawberries—are as yet grown on a very limited scale, though the large yields and the good prices obtained are causing a rapid increase in the acreage. The Snyder and Lawton blackberries and the Cuthbert raspberry are of fine quality and at present the most popular varieties. Strawberries produce from 200 to 300 crates of 24 quarts each per acre and are disposed of locally at good prices.

The growing of flower bulbs has been carried on in the area for several years, under the supervision of the United States Department of Agriculture. The limited acreage under cultivation thus far has demonstrated that both the soil and climatic conditions are well adapted to this industry, and that tulip, hyacinth, lillium candidum, and crocus bulbs, etc., equal to those imported from Holland, can be grown.

Dairying is one of the principal as well as one of the most profitable industries in the area. On account of the mild climate there is little need of warm shelter for the stock and there is an abundance of pasturage during the entire year. The dairy products of the area rank high in quality and the herds of improved breeds of dairy cattle are annually increasing.

The raising of poultry is also becoming an industry of considerable importance, and some of the rougher land near the larger local markets which is not well adapted to agricultural purposes is now being utilized for poultry farms.

The vigorous, healthy growth of all the agricultural products of the area, and the excellent results obtained from certain crops which have been grown from seed of local origin, seem to indicate that the

growing of seed to supply this and other areas of similar climatic and soil conditions, especially for such crops as cabbage, cauliflower, clover, timothy, and peas, would be profitable, and there is a possibility of this industry being developed. It is also probable that nurseries for the production of fruit trees will be established to supply the growing local demand.

The agricultural development of the area is of such recent origin that as yet little attention has been paid to adaptation of certain types of soil to certain crops. The areas of Lynden gravelly loam, which contain such a large percentage of gravel as to render them unsuited to crops requiring a frequent thorough cultivation, seem well adapted to fruit, and some of the finest orchards in the area are located on this type and on the Whatcom silt loam and Lynden silt loam. The well-drained areas of alluvial soil, the areas of Puget fine sandy loam, and of Puget silt loam always produce profitable yields of blackberries and raspberries. The larger yields of oats are obtained on the Puget clay, though the Puget silt loam is also well adapted to this crop. The Bellingham silt loam is well adapted to clover and timothy and is used chiefly for the production of hay. The Peat is the best type for celery, cabbage, and onions, but only a few very small areas are at present under cultivation. At present no well-established system of rotation is followed. In the river valleys, where the more extensive methods of farming are practiced, the usual rotation is oats, followed by timothy, and back to oats, but oats are frequently grown on the same fields for many consecutive years. Some rotation of crops is practiced on the small cultivated areas in the uplands, where potatoes, small fruits, and vegetables are the usual crops, but no regular system is followed. Where strawberries are grown, however, the plants give good yields for four or five seasons; the land is then cultivated to some other crop, usually potatoes or some other vegetable. The general tendency in the area is toward more intensive methods of farming, and the thorough cultivation of a small area to special crops is proving more profitable than general farming on a larger acreage.

The farm labor employed in the area is very efficient. The demand for laborers, however, by the lumber mills, logging camps, and other industries, at prices higher than can be obtained on the farms, has resulted in a scarcity of farm laborers, which is especially noticeable during the season of harvesting the hay and grain crops. The price paid for farm labor ranges from $30 to $40 with board, when hired by the month, and $2 to $3 when hired by the day.

The farms in the upland sections of the area seldom contain more than 40 acres, including the uncleared land, and the amount of land under cultivation on each farm ranges from 5 to 20 acres. In many sections of the uplands, and especially in the localities near the larger

markets, the land is being taken up in small tracts of 10 to 20 acres. In the river valleys and in the broad prairie north of Lynden the farms are larger and usually contain from 40 to 160 acres. As these lands are easily cleared, a large proportion of the farming land is now either under cultivation or is used as hay meadows and pastures.

The value of unimproved land in the uplands varies from $10 to $75 an acre, depending on location and on the character of the soil. Improved land in these sections varies from about $75 to $300 an acre, according to location and the extent of improvements. In the river valleys unimproved land brings from $50 to $100 an acre, while highly improved farms are valued at about $200 an acre.

Intensive farming, a more thorough cultivation of the soil, the careful selection of seed, a more general use of barnyard manure on every type of soil, and the use of tile drainage on the soils occupying low, shallow depressions are suggested improvements in the agricultural practices of the area.

SOILS.

Sixteen types of soil, including Peat, Swamp, and Tidal swamp and marsh, were encountered in the area surveyed. Many of these soils owe their origin directly to the weathering of glacial deposits which cover the underlying rock to an average depth of several hundred feet, but in many localities the material forming the soil has been greatly modified by the action of the streams or by redeposition in the basins of small lakes or in poorly drained depressions. These various modifying agencies have played an important part in the formation of the different types.

The soils of the area have been separated broadly into five divisions: (1) Those derived directly from the weathering of the glacial deposits; (2) those derived from the recent alluvial deposits laid down in the valleys of the larger streams; (3) those derived from material which has been redeposited in the shallow basins of small lakes or swampy depressions; (4) soils occupying the rough mountainous region, and (5) the beach deposits formed by the action of the waves.

The entire area, with the exception of the higher mountain peaks, was covered in comparatively recent geological times by glacial ice, and as the ice melted the older geological formations were covered by great mounds of drift or by more or less stratified deposits of silt, sand, and gravel laid down by the water from the melting glacier in the form of glacial outwash. The glacial till, which forms the low, rounded hills and ridges of the upland sections of the area, weathers into the fine silty material which forms the surface soils of the upland types. Where the deeper deposits of till occur the soil is underlain

by a compact mass of silt, clay, and fine sand, containing only a small amount of gravel and small bowlders. In some localities the finer material has been laid down as a shallow covering over coarser deposits of sand and gravel, which form a coarse, porous subsoil, such as underlies the surface soil of the Lynden silt loam.

This difference in the texture of the deeper subsoil makes a decided difference in the agricultural value of the two principal upland types.

The deep deposits of stratified sand or gravel found in the old glacial valley, which extends across the central part of the area, were probably laid down by water during the period when this valley served as an outlet for the water from the melting ice. The two light sandy loam soils which occur in this section are derived from these sandy deposits. The Lynden sandy loam, which has the coarser texture of the two, occupies the low sandy ridges and gently rolling terraces which extend across the north-central part of the area in the same general direction as the valley. The small areas of Lynden fine sandy loam, however, usually occur near the outer edge of the glacial valley, where the deposits laid down by the water contain a larger percentage of fine sand and silt.

The stratified gravel deposits, which occur more or less extensively in many sections of the area, forming the soil mapped as Lynden gravelly loam, represent the coarser materials deposited as glacial outwash by the waters of the melting ice.

The recent alluvial deposits in the valleys of the Nooksack and Sumas rivers consist of fine sand, silt, and clay. At times of overflow the coarser material held in suspension is deposited in the swifter currents near the present channels of the streams, forming the low sandy ridges adjacent to the river courses which give rise to the Puget fine sandy loam.

The broad valleys of both the Nooksack and Sumas rivers were formerly covered by a deposit of sand, but over a large proportion of these valleys the sand has been covered by more recent sediments of silt and clay laid down during times of overflow. In the shallow depressions, where water has collected and stood for long periods, the silt deposits are often many feet in thickness and give rise to the heavier alluvial soil mapped as Puget clay. Over the greater proportion of these valleys, however, the silt deposits have an average thickness of only about 20 to 30 inches, overlying the fine sandy subsoil, forming the soil which has been classed as Puget silt loam. Many more or less extensive deposits of partially decomposed organic matter occur in both the old glacial valley and in the more rolling sections of the area. These accumulations of Peat often cover the underlying soil to a depth of 10 feet or more. They are the result of the slow decomposition of large accumulations of vegetable matter in areas where the natural drainage is insufficient.

Many small, shallow basins or broad, poorly drained depressions occur in various sections of the area. Some of these represent the former basins of small lakes or ponds, while others are simply large depressions almost completely surrounded by rolling uplands, such as are frequently found in glaciated areas. The small lake basins have been gradually filled up by material washed into them from the surrounding uplands, and the soils usually consist of heavy silty loam containing a large amount of organic matter. The heavier type of soil found in these areas has been mapped as Bellingham silt loam.

In the larger basins, such as that occupied by the Custer silt loam, the finer particles of silt and clay, held in suspension by the water which formerly covered the areas, were gradually laid down over the coarser sandy deposits of an earlier period. The silty material covers the underlying sand to an average depth of 20 to 30 inches. A large proportion of the areas occupied by both the Custer silt loam and Custer loam was formerly covered by deposits of organic matter, but this has either been burned off recently or during some great forest fire in the past.

The smaller basins occupied by the Custer loam usually occur adjacent to areas of the light sandy soils, and the material which has been washed down and redeposited in these poorly drained areas contains a higher percentage of sand than that which forms the Custer silt loam. The subsoils of the two types are very similar in texture, and the sand underlying both types is often cemented into a compact mass by iron, the content of which is high. The larger areas of this character occur in the Custer loam, although there are no large deposits of bog iron, such as are found in the area occupied by the Custer silt loam.

The soil occupying the mountainous part of the area mapped as Whatcom stony loam contains a large amount of rock fragments and small bowlders and, as a whole, is of low agricultural value. This soil is principally derived from the weathering of glacial drift, but areas of rock outcrop frequently occur on the steeper slopes, and the material formed from the disintegration of the underlying rocks has also entered into the formation of the soil, especially along the slopes of the higher elevations.

The beach deposits are of small extent and of little or no agricultural value. They consist of coarse sand and gravel, which have been laid down along the shores of small inlets and bays by the action of the waves.

When properly cultivated the soils of the area are very productive and produce profitable yields of all crops adapted to the climate. The Whatcom stony loam is similar in texture, topography, and agricultural value to the rough, mountainous land mapped as Miami stony

loam in the Everett area, Washington. The Puget silt loam is also similar to the soil found in the Snohomish and Stilaguamish valleys. The Coastal beaches have many of the characteristics of the Galveston coarse sand of the Everett and Island County areas, but contain a higher percentage of rounded waterworn gravel.

The following table gives the name and extent of each soil type found in the area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Whatcom silt loam	62,592	25.6	Custer silt loam	8,960	3.6
Lynden sandy loam	30,208	12.4	Custer loam	8,128	3.3
Whatcom stony loam	28,608	11.6	Puget clay	7,424	3.0
Lynden gravelly loam	16,640	6.8	Lynden fine sandy loam	5,696	2.3
Peat	16,640	6.8	Swamp	2,816	1.1
Lynden silt loam	16,256	6.6	Coastal beaches	832	.3
Puget fine sandy loam	13,888	5.7	Tidal swamp and marsh	320	.1
Puget silt loam	13,632	5.5	Total	245,696	.....
Bellingham silt loam	13,056	5.3			

WHATCOM SILT LOAM.

The soil of the Whatcom silt loam consists of a light-brown to reddish-brown silt loam, with an average depth of 15 inches, containing a considerable quantity of organic matter. A few fine gravel or small iron concretions are frequently found in the soil, but as a whole it has a fine silty texture.

The subsoil consists of a heavy loam or silty loam of a light drab to gray color, which contains an appreciable quantity of coarse material, but also enough silt and clay to make it sticky and plastic when wet and to give it a compact, massive structure. A little gravel is often found in the upper part of the subsoil, but the quantity of this material usually decreases with depth, and the lower part of a 3-foot section is a dry, compact, heavy loam which contains a high percentage of silt and clay. A few small glacial bowlders are occasionally found scattered over the surface or embedded in the soil or subsoil.

The largest unbroken area of the Whatcom silt loam occupies the uplands in the southern part of the survey, but other extensive areas occur in almost every section of the area surveyed. The surface is distinctly rolling, with low, rounded hills and slopes seldom steep enough to cause erosion. Many shallow depressions almost completely surrounded by the low hills and ridges occur and in some localities small knolls of glacial drift with intervening poorly drained kettlelike depressions. The finer material washed down from the higher areas is redeposited in these depressions, giving rise to small areas of the Bellingham silt loam, and where of sufficient extent they have been indicated on the soil map, but many areas only a few

square rods in extent are found scattered over every large area of the Whatcom silt loam, and these could not be shown. With the exception of such small depressions the soil is well drained.

The Whatcom silt loam supports a heavy growth of fir, cedar, and hemlock timber, and it is often very difficult to remove the stumps and windfalls, even after the land has been cleared of merchantable timber. The soil is very productive, breaks up into a fine loamy condition, giving a splendid seed bed, and is easily kept in good cultivation. No large areas have been cleared, and the farms are small, the cultivated area seldom exceeding 20 acres. The small acreage of this soil now under the plow is proving very profitable, and the extent of cleared land is steadily increasing.

The soil seems well adapted to strawberries, Irish potatoes, vegetables, and to such fruits as apples, pears, plums, prunes, and cherries.

The small acreage seeded to clover and timothy has demonstrated that these crops, especially clover, do exceedingly well. The yield of hay averages from 3 to 4 tons per acre. Oats and barley produce very fair yields, but owing to the fact that such a small acreage of each farm is under cultivation the land is usually used for crops better suited to intensive farming. Peas, cabbage, and other garden truck are grown for the local markets and profitable yields are secured.

Strawberries yield from 200 to 300 crates of 24 quarts each per acre, and when properly cultivated the plants will continue to bear for five seasons. Hill cultivation apparently gives the best results. Blackberries and raspberries also do well. Irish potatoes yield an average of 8 to 10 tons per acre, and the product obtained is of very fine quality.

The small orchards located on this soil produce large yields and are in a very flourishing condition, although little attention is given to spraying.

The uncleared areas of the Whatcom silt loam are valued at $20 to $100 an acre, according to location; the cultivated land at $100 to $300 an acre, and highly improved land near the larger markets, from $500 to $700 an acre.

The following table gives the results of mechanical analyses of a sample of the soil, subsoil, and lower subsoil of the Whatcom silt loam:

Mechanical analyses of Whatcom 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.*
16976	Soil	0.7	5.4	3.3	10.7	5.4	63.1	9.5
16977	Subsoil	1.4	5.8	4.5	16.4	9.4	49.6	13.1
16978	Lower subsoil	1.5	5.4	4.1	15.6	10.3	48.5	14.7

LYNDEN SILT LOAM.

The soil of the Lynden silt loam to an average depth of 15 or 20 inches consists of a light-brown, silty, very fine sandy loam, containing a considerable quantity of organic matter. Some fine gravel and coarse sand particles are usually present in the soil, but not in sufficient quantities to have a marked influence on its texture. The subsoil consists of a compact mass of gravel and sand. The sand content varies in texture from fine to coarse, the coarser grades predominating, while the gravel is rounded and varies in size from fine particles to cobbles several inches in diameter.

The largest area of this soil occurs in the western part of the survey, occupying the greater proportion of the rolling uplands bordering the coast between Birch Bay and Lummi Bay. Another extensive area is found in the northwestern part of the survey, while smaller bodies appear in various other sections of the uplands.

The topography as a whole is rolling, but the hills are low and rounded, sloping gently toward the intervening valleys. Large, gently undulating or comparatively level areas occur at frequent intervals. The topographic features, together with the porous character of the subsoil, insure good natural drainage and in some places the type is too thoroughly drained for the best results with the crops grown.

The soil is derived from the weathering of glacial sediments of fine sand and silt, which were laid down over coarse glacial deposits of sand and gravel. It supports a very heavy growth of fir, cedar, and hemlock, and it is very difficult to clear the land for farming purposes. Only a limited acreage is under cultivation.

The Lynden silt loam is well adapted to fruit growing, and some of the best orchards in the area are located on it. Very large yields of apples, pears, plums, prunes, and cherries are obtained, and the fruit is of fine quality. Small fruits, such as raspberries and blackberries, are grown to a limited extent and do well, especially during a wet season, but the average yields to the acre are not so large as those obtained on the alluvial soils of the river valleys. Strawberries, however, do exceedingly well, and the yields often equal those obtained on any other soil in the area. Clover and timothy are grown to a limited extent, and while the yields are not as large as on some of the soils that have a heavier subsoil, a very fine quality of hay is produced. Clover seems better adapted to this soil than timothy, and usually gives better results. This land produces a fine quality of Irish potatoes, the yields averaging 200 bushels an acre. When well cultivated and heavily manured, much larger yields have been secured. Vegetables do well, especially in a wet season. These crops, however, sometimes suffer during a dry season, owing to excessive drainage, the result of the porous character of the subsoil.

The cultivated areas of the Lynden silt loam are valued at $100 and $200 an acre, according to the extent of the improvements. The uncleared lands range in value from $35 to $75 an acre.

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

Mechanical analyses of Lynden 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.*
17705	Soil	6.0	8.4	1.0	1.6	19.1	53.3	9.8
17706	Subsoil	19.3	43.6	6.0	6.9	4.0	14.7	4.6

LYNDEN SANDY LOAM.

The Lynden sandy loam to an average depth of 12 to 15 inches is a gray to light-brown sandy loam, underlain by gray, loamy sand of a more or less stratified structure, which often contains an appreciable amount of coarse sand and fine gravel. The sand content of this soil frequently varies in texture within areas of very limited extent, as, for instance, along some of the gentle slopes where the surface has become slightly eroded, and a small amount of the coarser material composing the subsoil has become mixed with the soil, giving it a slightly coarser texture than that which occupies the more level areas. The areas bordering the present valleys of the rivers also contain a higher percentage of coarse sand particles than those found along the outer edge of the old glacial valley, where the soil grades into types of a more silty texture or into areas of the Lynden fine sandy loam.

These slight variations in texture, however, are not great enough to affect the agricultural value of the type as a whole, and the areas of finer or coarser texture occur so frequently within such small areas that it was found impracticable to attempt their separation in a map of the scale used.

The sandy deposit which forms the subsoil usually becomes coarser in texture as the depth increases, but small pockets of a finer textured sand or of fine gravel are often encountered.

The Lynden sandy loam occurs in more or less extensive bodies in almost every part of the broad glacial valley which traverses the central part of the area from its eastern to western boundary. The main bodies of the type, however, extend across the central and west-central sections of the area, following very closely the general direction of the main branches of the broad valley. The topography is gently rolling. The ridges and knolls are low and rounded and slope gently toward the broad, comparatively level areas intervening.

The soil has suffered very little from erosion except in a few limited areas on the steeper slopes bordering the present river valleys or some of the smaller stream courses.

The character of the surface, together with the sandy texture of the soil and subsoil, insures good natural drainage, causing the soil to warm up early in the spring and enabling the farmer to cultivate the land immediately after the spring rains.

The deposits of sand which form the subsoil of this type were probably laid down by floods during the period when the valley served as an outlet for the waters from the melting glacier. No large bowlders occur, and the stratified structure seen in some of the deeper cuts indicates deposition by water.

Up to the present time only a small area of the Lynden sandy loam has been cleared and put under cultivation. The greater proportion of it is still covered by a heavy growth of timber or by the stumps, windfalls, or underbrush left by the lumberman. When properly cultivated the soil produces very profitable yields of potatoes, fruits, and small fruits. Both clover and timothy have been grown on a limited acreage with good success. The yields are not as large as those obtained on some of the soils of heavier texture, though the hay is of fine quality. This soil seems well adapted to the growing of early vegetables and large yields are always secured. Field peas and garden peas do well, the former often producing from 50 to 60 bushels per acre. The small orchards located on this type are in a very flourishing condition and produce large yields of apples, pears, plums, prunes, and cherries.

The "logged off" areas of this land are valued at $30 to $50 an acre. The cleared land is worth from $75 to $300 an acre, according to the location and improvements.

The following table gives the average results of mechanical analyses of samples of the soil and subsoil of the Lynden sandy loam:

Mechanical analyses of Lynden 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.*
17044, 17046, 17707.	Soil	4.7	31.6	15.7	11.1	1.1	28.7	7.1
17045, 17047, 17708.	Subsoil.....	2.9	40.8	23.4	20.0	1.6	8.0	3.4

LYNDEN FINE SANDY LOAM.

The soil of the Lynden fine sandy loam is a light-brown to reddish-brown, fine sandy loam, having an average depth of 15 to 20 inches, and containing enough silt and clay to give it a very fine loamy tex-

ture. The subsoil consists of a very light-brown to gray, fine sandy loam, which usually contains a large amount of silt in the upper 12 to 15 inches, but gradually becomes lighter in texture as the depth increases, grading at about 30 inches into a fine loamy sand.

The lower part of the 3-foot section is usually quite sandy, and the greater proportion of the whole type is underlain at a depth of 3 to 5 feet by a compact loamy sand, which is slightly coarser in texture than the upper subsoil. Small pockets of fine gravel sometimes occur in the deeper subsoil, but these are of rare occurrence and are seldom more than a few square rods in extent. The soil, on account of its fine loamy texture, is easily reduced to a state of thorough cultivation.

The largest area of the Lynden fine sandy loam occurs in the west-central part of the survey, a few miles southeast of the town of Ferndale, and another area of considerable size is found in the northwestern corner. Several other smaller bodies of this type are encountered in the western and west-central sections of the survey. This soil usually occurs along the outer border of the old glacial valley and adjacent to areas occupied by soils of a heavier silty texture. The greater proportion of each of the several areas occupied by this type is comparatively level, but the low ridges, gentle swells, and low, rounded knolls give the type as a whole a very gently undulating topography. The soil in the more level areas contains the larger quantity of silt, and this, together with the large content of organic matter, often causes the surface to have many of the characteristics of a light silty loam. On the other hand, that occupying the low knolls and ridges frequently contains a higher percentage of fine sand and is slightly lighter in texture than the greater proportion of the type. The soil has good natural drainage. It is not subject to damaging erosion.

The Lynden fine sandy loam is derived from the finer sediments of sand and silt deposited by flood waters during the period of ice invasion. It supports a heavy forest of fir and cedar and a dense undergrowth of ferns and other native vegetation. Only a very small proportion of the type has been cleared and put under cultivation. It produces very fair yields of all crops grown. Oats yield on the average 60 bushels an acre and Irish potatoes about 200 bushels, though when thoroughly cultivated and heavily manured much larger yields have been secured. Clover and timothy have been successfully grown on a limited acreage and produced about 3 tons of hay an acre. Cabbage, cauliflower, carrots, pumpkins, garden peas, cucumbers, and other vegetables do well. Canadian field peas yield from 50 to 60 bushels an acre. Many small orchards of various kinds of fruit are located on this type and produce large yields.

The following table gives the results of mechanical analyses of the soil and subsoil of the Lynden fine sandy loam:

Mechanical analyses of Lynden 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.*
17733	Soil	0.1	5.7	7.8	29.5	11.5	35.9	9.1
17734	Subsoil	.0	3.1	6.7	29.7	23.6	28.9	8.2

CUSTER SILT LOAM.

The soil of the Custer silt loam, to an average depth of 15 to 20 inches, is a gray to light-drab silty loam, often slightly mottled with yellow iron stains. The soil contains a considerable quantity of organic matter, and in some small areas it is covered by a shallow deposit of peat or muck, varying in depth from 1 to 6 inches. The sand content increases with depth, and there is a slow gradation from the heavier silty soil into the lighter textured subsoil.

The subsoil consists of a compact loamy sand, which often contains pockets of small gravel and sometimes at lower depths pockets or thin strata of heavy silty clay. There is a larger proportion of silt and clay in the upper part of the subsoil, giving it a loamy texture and causing it to be sticky and plastic when wet, but the percentage of finer material rapidly decreases with depth, and the lower part of the 3-foot section is a compact loamy sand.

The subsoil contains a large quantity of iron, which often cements the sand particles into a hard, compact mass and causes a slight yellow mottling. Small iron concretions are found throughout the soil and subsoil and in some places large beds of bog-iron ore occur. Such deposits are not continuous or of large textent. Where they affect the agricultural value of the soil the areas have been indicated on the soil map by means of a symbol. The more important areas, where the gravel deposits already referred to influence the texture of the subsoil, have also been indicated on the map by means of a symbol.

The Custer silt loam is found in one large unbroken area in the northern part of the survey. It is known as "Lynden Prairie." Formerly the basin of a shallow lake, it has passed through the stages of a poorly drained marsh, with its dense covering of swamp vegetation and consequent deposit of peat or muck. When drained and cleared for agricultural purposes, the peaty surface soil was burned off over the greater proportion of the prairie, but an extensive deposit of organic matter is still found in the extreme northeastern corner. The surface is level to very gently rolling and the natural drainage is poor. Many large drainage ditches have been constructed, and a large part of the land is at present fairly well drained, although many

small bodies in the shallow depressions or more level areas still need more thorough drainage to fit them for agriculture.

The Custer silt loam is of lacustrine origin. The surface material, composed mainly of silt and clay, was laid down in the waters of a shallow lake. The coarser sandy material of the subsoil was laid down in the old lake basin at an earlier period, and the high organic content is the result of the drying up or filling of the lake and the growth and decay of rank swamp vegetation.

Owing to the fact that the land could be easily cleared and made ready for farming, the greater part of the Custer silt loam is under cultivation. For the same reasons the agriculture is more extensive than in the rolling upland sections, where the heavy timber growth has so far limited the areas under cultivation.

The principal crops are oats and hay. Oats yield on an average 50 to 60 bushels per acre, though a yield of 80 to 100 bushels has been secured on well-cultivated land in favorable seasons. Timothy and clover do well, producing 2 to 3 tons per acre, and even 3½ to 4 tons is not uncommon. Canadian field peas are successfully grown, yielding 40 to 50 bushels an acre. Irish potatoes do well on the well-drained land, often yielding 300 to 400 bushels per acre. Where the land is thoroughly drained and well cultivated very good yields of cabbage, beets, peas, pumpkins, and other vegetables are obtained. Tree fruits and small fruits also give good results on the better-drained areas.

The improved farm land of this type of soil is valued at $100 to $200 an acre, depending upon location and drainage.

The following table gives the results of mechanical analyses of the soil and subsoil of the Custer silt loam:

Mechanical analyses of Custer 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.*
17709	Soil	0.3	1.4	2.2	8.6	14.2	55.2	17.5
17710	Subsoil	.9	15.1	19.5	31.9	10.8	15.3	6.6

LYNDEN GRAVELLY LOAM.

The soil of the Lynden gravelly loam is a light-brown loam or silty loam, containing a large quantity of rounded, waterworn gravel. It has an average depth of 10 inches. The coarser material varies in size from coarse sand to small, rounded cobbles several inches in diameter, but is principally medium-size gravel. Gravel and a few small bowlders are frequently scattered over the surface, the quantity varying considerably within small areas. In some places, especially along the slopes where erosion has been greater, such coarse material

often covers 60 per cent of the surface, while in adjoining areas the gravel occurs in beds covered with 2 to 4 inches of a brown loamy soil comparatively free from stones.

The subsoil consists of a more or less stratified mass of fine and coarse gravel and small, rounded cobbles. The interstitial material is composed of sand varying in texture from fine to coarse, with the latter predominating.

The stratified structure of these gravel deposits is often seen in the deeper cuts or gravel pits. The gravel beds frequently occur in layers from 2 to 10 feet thick, and are sometimes separated by thin strata of sand. Both the sand and gravel, however, occur in pockets or in compact masses, and there is little uniformity in the formation as a whole.

More or less extensive areas of the Lynden gravelly loam are found in almost every locality embraced by the survey. The two largest bodies are found in the northwestern section of the area. One occupies the gently rolling uplands along the Canadian boundary line, just east of Blaine, the other the greater part of the small peninsula projecting into Puget Sound just south of Blaine, between Drayton Harbor and Birch Bay. Other less extensive areas are found near the base of the range of mountains which crosses the eastern and southeastern parts of the survey, and in various sections of the old glacial valley. The topography is quite rolling, but many of the less extensive areas occupying broad terraces or low ridges are comparatively level or gently rolling.

The topographic position of this soil, together with the gravelly texture of the subsoil, insures rapid drainage, and, as a whole, the type is too thoroughly drained, and the crops, only limited acreages of which are grown, frequently suffer from the lack of moisture. The soil is derived from the coarser glacial deposits of sand and gravel, the structure of which, especially in the broad glacial valley, indicates that they were laid down by flood waters, probably as glacial outwash. The coarser material was later covered by a deposit of fine sand and silt, forming the present surface soil.

A very small percentage of the Lynden gravelly loam has been cleared, the greater part being still covered by a heavy growth of virgin forest or by the remnants of such forests left by the lumberman. The soil seems especially adapted to the growing of fruits, and much of the cleared land is used for their production. Apples, pears, plums, prunes, and cherries do exceedingly well, and the acreage devoted to orchards is annually increasing.

The gravelly nature of the soil and the difficulty of cultivating it properly render it poorly adapted to crops which require frequent turning of the soil. Very fair yields of Irish potatoes have been

secured on the areas having a comparatively small percentage of gravel in the surface soil.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of Lynden gravelly loam:

Mechanical analyses of Lynden gravelly 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.*
17729	Soil	7.6	19.1	7.9	9.8	3.0	40.1	12.2
17730	Subsoil	16.7	43.9	14.1	15.1	1.9	3.6	4.0

WHATCOM STONY LOAM.

The soil of the Whatcom stony loam is a light silty loam or loam of a reddish-brown to light-brown color. The depth of the soil varies from 10 to 20 inches, with an average of 15 inches. The surface is usually strewn with gravel and small stones, while imbedded in the soil are numerous bowlders varying in size from a few inches to several feet in diameter. The soil varies in depth and texture with its topographic position. On the lower ridges and bench lands or terraces it is usually a light silty loam with a depth of 15 to 20 inches, but on the steeper slopes and mountain sides the soil is shallow, lighter colored, and contains a higher percentage of sand and gravel. In some places the soil has been entirely removed by erosion, exposing the subsoil, and frequently the underlying rock. Stones, gravel, and bowlders occur more frequently on the mountain sides and steeper slopes than in the soil of the bench lands.

The subsoil is a heavy loam to silty loam of a light-gray color, containing usually a large quantity of gravel, small stones, and bowlders. Where the underlying rock is several feet below the surface, the subsoil in the lower depths is a light-gray to bluish-gray silty clay, comparatively free from gravel. The underlying rock protrudes at irregular intervals throughout the type. The coarser material found in the soil and subsoil is derived from the underlying formation.

Where the Whatcom stony loam occupies the lower hills and bench lands it can be profitably cleared and put under cultivation, since the rock outcrops, fragments of stone, and gravel are not so numerous as to interfere seriously with the tillage and handling of crops. The more precipitous slopes, however, could only be used for grazing, and will probably be more profitably kept in forest.

The largest body of this soil lies in the extreme southeastern corner of the survey and covers an area of about 20 square miles. The next largest body extends along the eastern boundary of the survey for a distance of 8 miles or more, and is a trifle less than 2 miles broad at its

widest point. It is about 11 square miles in extent. Another body containing from 9 to 10 square miles was encountered in the vicinity of Silverbeach. Kings Mountain and a small area near it were also included in this type.

The Whatcom stony loam occupies largely the lower ridges, bench lands, and foothills, which form a part of the extreme western range of mountains included in the Cascade Range. The topography is necessarily hilly to mountainous, with an elevation from 300 to more than 3,000 feet, the highest point being in the southeastern part of the area.

The drainage of this soil is rather excessive, and with a less humid climate crops grown on it would be seriously affected by drought. It frequently happens that the deposition of glacial material has so interfered with the natural drainage as to result in the formation of wet depressions, which are usually occupied by Peat. These areas can be drained readily by artificial outlets. The drainage of the bench lands or terraces is not so excessive as to impair their value for agriculture.

The Whatcom stony loam is both residual and glacial in its origin, as shown by the presence of rounded glacial bowlders and fragments of rock in the soil and subsoil. The soil of the lower ridges and foothills is derived largely through the weathering of glacial drift, but on the steeper slopes and mountain sides the weathered material of the underlying rock formation has entered largely into its composition.

The native growth on this soil is fir, cedar, hemlock, and alder. It also has a heavy growth of ferns and underbrush. On account of its rough and broken topography very little effort has so far been made to remove the timber. The forest fires which occasionally pass over these sections, however, have destroyed much of the original growth. The timber, if properly handled, will always be a valuable asset.

A very limited acreage of the Whatcom stony loam is at present under cultivation. The rough, broken character of the larger part of this land limits the acreage suitable for cultivation. The value of the land for fruit growing is being demonstrated by those who have already taken up farms. It is particularly well adapted to the growing of apples, pears, plums, and other deciduous fruits, and it is claimed the fruit is less affected by late frosts in the spring on this soil than on many others in the area. Good yields of clover, timothy, and oats are obtained on the limited acreage cultivated to these crops. The raising of poultry and sheep would give good returns. Several small tracts in the vicinity of Silverbeach have been used for raising poultry and supplying eggs to the local market.

At the present time the value of this land depends largely upon the amount of standing timber, and its accessibility.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of the Whatcom stony loam:

Mechanical analyses of Whatcom stony 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.*
17713	Soil	2.1	8.1	5.3	14.4	20.4	36.9	11.9
17714	Subsoil	3.5	8.2	6.6	17.6	19.7	34.0	9.7

BELLINGHAM SILT LOAM.

The soil of the Bellingham silt loam, to an average depth of 12 inches, is a dark-brown to drab-colored heavy silt loam, carrying a large quantity of decomposed organic matter. When turned up with a plow and in a dry condition, the soil becomes lighter in color and has a light-brown to gray appearance. The subsoil is a heavy, drab-colored to slightly mottled silt loam, which becomes somewhat heavier and more compact as the depth increases, and at 30 to 36 inches usually has the characteristics of a silty clay. Small pockets of gravel or coarse sand are frequently encountered in the deeper subsoil.

The Bellingham silt loam occurs in all parts of the survey, with the exception of those sections of the old glacial valley occupied mainly by a soil of a light sandy texture. It is found in small bodies, varying from a few square rods to about 1 square mile in extent. When properly cultivated the soil breaks up into a loamy, friable condition, but if plowed when wet, as in a poorly drained area, it has a tendency to clod, and it is difficult to reduce to a state of good tilth.

The soil occupies shallow depressions or small basins, which are almost completely surrounded by areas of more rolling topography. The smaller areas are found in the kettlelike depressions associated with the low knolls and ridges of the rolling uplands occupied by the Whatcom silt loam. Many of these depressions are not large enough to indicate on a map of the scale used, being only a few square rods in extent, but the soil is fairly typical of that found in the larger areas. The surface of the larger areas is comparatively level, but low mounds and gentle swells often give it, on the whole, a very gently undulating topography.

The Bellingham silt loam is naturally poorly drained. The shallow basins receive the drainage of the surrounding uplands and usually remain in a wet, partially flooded condition during the winter

months. The majority of these can be thoroughly drained without much difficulty. Tile drainage is practiced on a small scale and has greatly increased the agricultural value of the land.

The Bellingham silt loam is derived from material washed from the neighboring uplands. The structure as well as the general appearance of this material, especially that forming the deeper subsoil, seems to indicate that the material has been laid down in water during the periods when these basins were small ponds or lakes, or were in a wet, swampy condition. The large amount of humus in the soil owes its origin to the slow decomposition of the rank growth of vegetation which flourishes in such places.

This soil does not support a heavy growth of timber and is cleared with less difficulty and expense than the heavily forested uplands. The principal trees are cedar and alder, and the areas are known as alder bottoms.

A large proportion of the hay produced in this area is grown on the Bellingham silt loam, and it seems well suited to both timothy and clover. The yields range from 3 to 4 tons per acre. The poor natural drainage of the land has resulted in its general use as hay meadows, but when thoroughly drained, especially by tile, it produces very profitable yields of vegetables. Cabbage, cauliflower, peas, beets, and potatoes do exceedingly well. It is not as well adapted to fruit growing as the rolling uplands, although some kinds of small fruits give good results

The value of this land varies from $30 to $200 an acre, according to its location, its condition as to drainage, and the extent to which it has been improved.

The following table gives the average results of mechanical analyses of the Bellingham silt loam:

Mechanical analyses of Bellingham 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.*
17725, 17727	Soil	0.3	1.3	0.4	2.7	8.3	68.7	18.1
17726, 17728	Subsoil	.2	.7	.5	4.1	8.5	72.1	13.9

CUSTER LOAM.

The soil of the Custer loam is a gray to dark-brown loam, which has an average depth of about 10 to 12 inches. The upper part of the soil contains a large quantity of silt and the texture of the first 2 to 5 inches of the uncultivated land is often quite silty. The coarser material consists of various grades of sand, the proportion rapidly increasing with depth, as the sandy subsoil is approached. The Custer loam usually contains a large percentage of organic matter in

various stages of decomposition, the remains of the rank vegetation usually growing in moist situations. In some small areas the surface is covered by a shallow deposit of peat, seldom more than a few inches deep, while in others the organic matter is more thoroughly decomposed and has become intimately mixed with the fine silty surface soil.

The subsoil is a compact loamy sand, often containing pockets of fine gravel. The upper part usually carries a considerable quantity of silt derived from the soil, but the silt content rapidly decreases with depth, and the deeper subsoil has a very light sandy texture. The large quantity of iron present in the sandy subsoil often cements the sand particles into a hard, compact mass, and small beds of bog iron ore and pockets of iron concretions are frequently encountered at a depth of 1 to 3 feet below the surface.

The two largest areas of the Custer loam are found in the west-central part of the survey, one near Custer and the other near Enterprise. Smaller areas, however, occur in various parts of the old glacial valley. The soil occupies low, poorly drained depressions, which are usually partially surrounded by gently rolling uplands occupied by the Lynden sandy loam. The surface of these shallow basins is level or gently undulating.

A very small percentage of this type is under cultivation and this is usually in a poorly drained condition. It produces very fair yields of oats and hay, and when well cultivated the better drained areas produce good yields of potatoes and other vegetables. The average yield of clover is estimated at 2 to 3 tons and of oats about 40 to 50 bushels per acre. When this soil shall be thoroughly drained and well cultivated its agricultural value will be greatly increased.

The following table gives the results of mechanical analyses of the soil and subsoil of the Custer loam:

Mechanical analyses of Custer 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.*
17701	Soil	4.7	32.8	10.5	8.3	5.4	29.3	8.8
17702	Subsoil	4.0	55.4	15.0	8.6	2.2	8.1	6.6

PUGET FINE SANDY LOAM.

The soil of the Puget fine sandy loam is a dark-gray to brown silty fine sandy loam. The silt content is greater where there is a slow gradation from the Puget fine sandy loam to the Puget silt loam and Puget clay or near the boundary line between these types. The average depth of the soil is 12 or 15 inches. Iron stains are some-

times encountered at various depths, but the dark color of the soil is due almost entirely to high organic matter content.

The subsoil is usually lighter, both in color and texture, than the soil, and iron stains like those found in the soil are more plentiful. The sand content is slightly coarser than in the soil, and the proportion of silt and other fine material is lower, except where an occasional thin layer of clay or sandy clay has been deposited with the sand. The subsoil is uniform to a depth of several feet.

The texture of both soil and subsoil is more or less variable along the smaller streams, but no attempt was made to separate these variations owing to the small areas over which they occur. The soil, being of a loose, incoherent structure, is easily cultivated, and even if plowed when moist breaks down into a light mellow loam. It is probably the easiest soil to till in the area.

The Puget fine sandy loam is confined almost entirely to the present valleys of the Nooksack and Sumas rivers, where it occurs immediately along the streams as a continuous body, varying in width from a few rods to a mile or more and having a very irregular boundary line. It occupies low ridges or comparatively level areas, which have a gentle slope away from the streams.

The loose, incoherent structure of both soil and subsoil permits of a free movement of the excess of soil moisture to lower depths, and on account of the slightly elevated position the excess of water falling upon the surface readily passes off into the natural drainage courses or into more depressed areas. The water table is usually several feet below the surface, insuring a warm, dry soil, except at times of high water. Some areas are still subject to overflows, which usually come at such seasons of the year as not to injure the crops to any appreciable extent.

The Puget fine sandy loam owes its origin to the deposition of material gathered up by the rivers in times of flood and laid down by the swifter currents during periods of overflow. The low, swamp-like basin near the mouth of the Nooksack River is rapidly being filled in by continued deposition of this sandy material.

The characteristic native growth is the willow. The land is easily cleared for cultivation, and hence a large proportion of it is now in farms, the percentage being greater than that of any other type in the area except the Custer silt loam.

This soil has been devoted almost exclusively to forage crops and pasture, with the exception of small areas in the vicinity of farm houses planted to orchards or small fruits and vegetables. Where the drainage is not impeded in any way, the soil is well adapted to fruits of all kinds, but more especially to raspberries and blackberries. The yield of red raspberries varies from 500 to 750 crates

per acre. When the soil is properly handled and careful attention is given to mulching and such methods of cultivation as will tend to conserve moisture there need be no fear of damage from drought. Large yields of potatoes may be obtained. The average crop is approximately 8 tons to the acre, although 10 tons have been harvested.

Where in close proximity to markets, the soil should be used more extensively for trucking. Timothy and clover are the leading forage crops, and yield from 2 to 3 tons of hay per acre. Oats produce heavy yields of grain of good quality.

The cultural methods practiced on this soil consist in breaking, harrowing, and seeding with the disk drill. Very little broadcasting is practiced. Seeding is usually done in the fall.

Land values vary with the character of improvements. The wild or unimproved land is held at $40 to $60 an acre and the improved farms at $100 to $200 an acre, and sometimes at a higher price, where accessible to markets.

The following table gives the results of mechanical analyses of the soil and subsoil of Puget fine sandy loam:

Mechanical analyses of Puget 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.*
17741	Soil	0.1	0.5	0.3	27.0	32.1	35.5	4.2
17742	Subsoil	.0	.5	2.0	51.8	30.6	11.1	3.1

PUGET SILT LOAM.

The soil of the Puget silt loam, to an average depth of 15 to 20 inches, is a light-brown to drab silt loam containing a considerable amount of fine and very fine sand. The subsoil consists of a light-brown to gray fine sandy loam which is often slightly mottled with yellow iron stains. A relatively large quantity of silt is present in the sandy subsoil, especially in the upper 5 or 10 inches where it grades into the silty surface soil. The sand content has a uniform fine texture and the deeper subsoil contains very few, if any, pockets of coarse sand or gravel.

Extensive areas of the Puget silt loam occur in the valleys of the Nooksack and Sumas rivers, where it occupies broad, shallow depressions and level to gently undulating areas, occurring between the low ridge of Puget fine sandy loam bordering the immediate banks of the stream and the uplands which lie on the outer edge of the river valley. The natural drainage in the level or gently undulating areas is fairly

good, but in the depressions it is often very poor and artificial drainage is necessary to obtain the best results.

Very little of the Puget silt loam in the valley of the Sumas River is at present subject to overflow, but large areas in the Nooksack Valley are flooded. The soil has been formed from deposits of fine sand, silt, and clay laid down by the waters of the rivers. The greater proportion of the river valleys was formerly covered by a fine sandy deposit which now forms the subsoil of this type; the soil proper has been formed from more recent deposits of silt and clay.

This soil can be cleared for farming with less difficulty than that occupying the rolling uplands, and on account of its fine silty texture is easily brought to a high state of cultivation. A large part of its area is either under cultivation or is utilized as pasture. The principal crops are hay and oats. The average yield of oats, which is an unfailing crop, varies from 70 to 100 bushels per acre. The hay grown consists of clover and timothy and the average yield per acre is about 3 tons of hay. Irish potatoes do well on the better drained land, yielding from 6 to 8 tons per acre. Both raspberries and blackberries are well adapted to the soil, and with careful culture yield from 400 to 700 crates, each of 24 quarts, per acre. Cabbage, beets, tomatoes, peas, and other garden truck are successfully grown for the local markets. Canadian field peas produce an average of 40 to 60 bushels per acre.

When cleared and cultivated this land is valued at $100 to $200 an acre; when uncleared it can be purchased for $75 to $100 an acre, according to location and drainage.

The following table gives the results of mechanical analyses of the soil and subsoil of the Puget silt loam:

Mechanical analyses of Puget 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.*
17717	Soil	0.1	0.9	0.4	1.4	8.5	74.7	13.7
17718	Subsoil	.0	.2	.1	25.2	30.7	38.2	4.6

PUGET CLAY.

The soil of the Puget clay is a drab or slightly mottled heavy silt loam, containing a large quantity of organic matter in various stages of decomposition. It has an average depth of 15 to 20 inches and grades into a heavy, slightly mottled, silty loam or silty clay subsoil, which is very similar in texture to the surface soil. The subsoil is usually in a more or less thoroughly saturated condition and is

sticky and plastic. This causes the material to have the characteristics of a soil of heavier texture.

The remains of old logs and deposits of partially decomposed organic matter are sometimes found in the deeper subsoil, and a considerable amount of decomposed vegetable matter is usually present throughout the 3-foot section.

The larger areas of the Puget clay are found in the valley of the Nooksack River, but a few small areas also occur in the valley of the Sumas. It occupies low, flat areas which are usually subject to overflow, and forms the low delta flats near the mouth of the river. The level marshes in the same situation are being gradually built up by the deposition of silt and clay from the river, and represent an early stage of the delta-land phase of this type.

The topographical position of this soil accounts for its poorly drained condition, and in areas where no artificial drainage is used the water table is very near the surface. Open ditches are usually employed to carry off the excess water, but even where this is done the subsoil remains in a saturated condition during the greater part of the year.

The Puget clay is derived from the silt and clay deposited in these low, flat areas by quiet waters during floods. A large proportion of these areas contains quantities of organic matter, the remains of decomposed swamp vegetation, as well as shallow deposits of Peat.

The land does not support a heavy growth of timber and can easily be put in cultivation. A large part of it is already cleared. Portions that are well drained are used for cultivated crops and the rest as pasture.

The soil is well adapted to oats, giving very large yields—on the better drained land from 80 to 100 bushels per acre, with reported maximum yields of 125 bushels per acre. Barley has been grown to a limited extent and produces an average yield of 45 bushels per acre. Wheat has also been grown in a small way and yielded well, but the grain produced was too soft for milling, and at the present time this crop is not grown in the area. Clover and timothy do well on the better drained areas, producing from 3 to 5 tons of a very fair quality of hay to the acre. With favorable moisture conditions in the soil, potatoes, vegetables, and small fruits thrive. Very few orchards have been set out, owing to saturated condition of the subsoil, but on well-drained soil orchards do well. Apples, pears, plums, and cherries are grown.

Tile drainage would greatly increase the agricultural value of the land. At present the price ranges from $75 to $200 an acre, according to location and improvements.

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

Mechanical analyses of Puget 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.*
16986, 17721.....	Soil	0.1	0.6	0.3	1.0	1.3	68.9	27.7
16987, 17722.....	Subsoil.....	.5	.6	.3	.9	1.0	72.2	24.0

COASTAL BEACHES.

The Coastal beaches consist of a coarse, loamy sand, containing a large quantity of rounded gravel. The color varies from gray to light brown, according to the quantity of organic matter present. The texture of the subsoil is like that of the surface, but in the lower depths it does not contain as much organic matter and is lighter in color.

This type of soil forms the sea beaches, which are seldom wide enough to indicate on a map of the scale used. The larger areas are found along some of the shallow bays and inlets, where the coast line has been gradually built out into the water by the continued deposition of sand and gravel by the action of the waves. The type is purely a beach deposit and is so limited in extent that it is of no agricultural importance.

SWAMP.

The area mapped as Swamp is situated in the lower valley of the Nooksack River and comprises about 2 square miles. This area remains wet and flooded during the entire year and supports a heavy growth of tules, coarse grasses, and other swamp vegetation. A large quantity of sediment is annually left in this area by the river at times of high water, and it is gradually being filled up by a sandy deposit similar to that which forms the Puget fine sandy loam. This area is at present too wet and poorly drained to be of any agricultural value.

TIDAL SWAMP AND MARSH.

An area mapped as Tidal swamp and marsh occurs at the mouth of a branch of the Nooksack River, known as the Lummi River. A smaller area is also located at the mouth of the main branch of the Nooksack. These areas have only a slight elevation above the tide and are often flooded by salt water from the sound at times of storms.

The marshes are covered by a heavy growth of coarse grasses and there is a mat 2 to 4 feet thick of fibrous organic matter formed from the remains of this vegetation in various stages of decomposition.

The underlying soil, a drab-colored heavy silt loam or silty clay, remains always in a saturated condition. Only by means of dikes and drainage, which would have to be done by pumping, can this land be reclaimed. In any event, the deep fibrous deposit of organic matter makes cultivation very difficult. These salt marshes have been formed by the deposition of silt and clay from the streams in the shallow water of the bay.

PEAT.

The deep accumulations of organic matter which occupy considerable areas in various sections of the area surveyed have been classed as Peat. This vegetable matter is in fibrous, partially decomposed condition, and the deposits vary in depth from 6 inches to more than 10 feet. These deposits at the surface usually have a dark-brown color. At a depth of 3 feet or more the color is usually darker and decomposition is in a more advanced stage.

Areas of Muck formed by the more thorough decomposition of this material are frequently encountered in all of the larger areas of Peat. The Muck areas are slightly darker in color than those occupied by the material of a more fibrous texture, and usually contain a higher percentage of silt and clay mixed with the organic matter. These two stages in the decomposition of these deposits are so closely related and grade into each other so frequently and within such narrow limits that it was found impracticable to separate them in a map on the scale of 1 mile to the inch.

The greater part of the peaty accumulations, however, has a coarse, fibrous texture, only the material found at a depth of several feet below the surface being decomposed sufficiently to be classed as Muck. One of the largest unbroken bodies of Peat, found in the northern part of the survey, covers an area of approximately 3 square miles in the broad flat plain or basin known as "Lynden Prairie." This whole basin was formerly covered by a deposit of Peat, but in the process of reclamation of the land the organic material has been largely burned off. An extensive area occupies the broad, poorly drained, depression east of Custer, and another area covering several square miles is found in the Nooksack Valley near the central part of the survey. Smaller deposits occupy small, poorly drained basins in many other localities. The larger areas also are found in poorly drained depressions, which receive the drainage water from the land surrounding them, but in several places similar deposits occupy knolls or ridges or the gentle slopes of the rounded hills. The Peat found here has been formed where small springs occur or where the drainage water from higher-lying areas seeps out. The rank growth of vegetation hinders the natural drainage of the land and the slow decomposition of this vegetable matter under the wet conditions gradually forms areas of shallow organic soils. Some of the areas of Peat

in the valley of the Nooksack River are subject to overflow at times of high water, and the silt and clay held in suspension by the water of the stream are deposited over the accumulations of organic matter forming a layer of silty soil, often several inches deep. These areas have been indicated on the soil map by means of a symbol.

The characteristic growth consists of cedar, jack pine, and dense, low bushes. Some areas support a growth of cranberry bushes and are locally known as cranberry marshes.

On account of its fibrous texture Peat is very difficult to cultivate and is used mainly for pasture or mowing lands. A few small areas have been drained and cultivated and yield fair crops of oats. Limited experiments have shown that the mucky areas will produce onions and celery profitably. Hay on the better drained areas does well and from 3 to 5 tons an acre are obtained, but it is of poor quality on account of the coarse wild grasses mixed with it.

SUMMARY.

The Bellingham area comprises 245,696 acres, or about 384 square miles of the northwestern part of Whatcom County, Wash.

For the most part the surface is rolling, but a glacial valley, which crosses the area from east to west and extends a branch to the northwest, has more gentle topography. A little of the area is mountainous.

Drainage is afforded by the Nooksack and Sumas rivers and Dakota and California creeks.

Settlement in the uplands is scattering; the river valleys are comparatively thickly settled.

Bellingham, population about 30,000, is the principal town and chief local market. Seattle and Tacoma, together with the Canadian cities, Vancouver and Victoria, offer ready market for all produce of the area.

Facilities for transportation, both by rail and water, are available.

The climate is mild throughout the year, and the rainfall is much less than in many parts of the " sound " country, being only 32 inches a year.

Grain and hay are the principal crops in the valleys, and small fruits, potatoes, and other vegetables in the uplands. Fruit growing is rapidly becoming one of the important industries. Dairying is important and profitable. Flower bulb growing has been tried and promises to be a money-making specialty. Farm labor is scarce but efficient.

Undeveloped farm land can be obtained for $10 to $75 an acre, while improved land ranges in value from $75 to $500 an acre.

Sixteen types of soil, including Peat, Swamp, and Tidal swamp and marsh are found. Of these the Whatcom silt loam is the most

extensive. Only a small proportion is under cultivation. The soil is productive and well adapted to tree and small fruits, and to potatoes and other vegetables.

The Lynden silt loam, an upland type, is well adapted to fruit. Small areas are used successfully in the production of vegetables. Only a limited acreage is under cultivation.

The Lynden sandy loam produces good yields of fruit, small fruits, and vegetables, but as yet no large areas of this type of soil are under cultivation.

The Lynden fine sandy loam—an easily cultivated soil—also produces good yields of tree and small fruits, and of clover and timothy hay.

Much of the Custer silt loam is cultivated. It produces good yields of oats, fruit, and vegetables.

Little of the Lynden gravelly loam is under cultivation. The orchards do well and vegetables also thrive on the more level areas.

Only a small part of Whatcom stony loam is suitable for agriculture. It occupies the mountainous parts of the area, and is valuable for its timber.

Occupying poorly drained basins, the Bellingham silt loam is used principally for hay. It is well adapted to clover and timothy, and where drained it produces fair yields of vegetables.

Another soil, the Custer loam, is in need of drainage. Drained areas give good yields of oats, hay, and vegetables.

The Puget fine sandy loam, found on a narrow ridge bordering the rivers, is a well-drained productive soil. It is used for small fruits and vegetables, and is especially well adapted to blackberries and raspberries.

When well drained the river bottom type, Puget silt loam, is a very productive soil. Seventy-five to 100 bushels of oats per acre may be secured. The soil is also well adapted to blackberries and raspberries.

The Puget clay, if adequately drained, produces large yields of hay and phenomenal yields of oats, ranging from 70 to 125 bushels, with occasionally yields of 150 bushels to the acre.

The nicer adaptations of soils to crops, so far as they have been determined to this time, may be summarized thus: For blackberries and raspberries, Puget fine sandy loam and Puget silt loam; for clover, the more level areas of Whatcom silt loam; for timothy, the Whatcom silt loam, Bellingham silt loam, and Puget silt loam; for tree fruits, all well-drained soils, but especially the Lynden gravelly loam; and for flower bulbs. the Whatcom silt loam and Lynden fine sandy loam.

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