SOIL SURVEY OF THE LAREDO AREA, TEXAS.

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DESCRIPTION OF THE AREA.

The Laredo area is located in the southern part of the State of Texas and embraces 99,520 acres, or about 155.5 square miles, in the southwestern portion of Webb County. It is 21 miles long north and south, but owing to the fact that the western boundary follows the course of the Rio Grande, it varies in width east and west from about 10 miles along the northern boundary to about 5 miles at the

FIG. 16.—Sketch map showing location of the Laredo area, Texas.

narrowest point near the center of the area. The area is bounded on the north, east, south, and partly on the west by that portion of Webb County not included in the survey. The greater proportion of the western boundary, however, is formed by the Rio Grande, which here marks the boundary line between the United States and Mexico.

The principal topographic features of the area consist of the level areas bordering the Rio Grande and the rolling hills and ridges of

the uplands. The level areas along the river vary in width from 3 miles to only a few hundred yards. The broader areas lie within the larger bends of the river, while in places, where the stream has cut in toward the uplands, the valley becomes narrower and sometimes disappears altogether, the rolling hills extending to the bank of the river and ending in steep perpendicular bluffs. Long, narrow ridges and low, rounded hills extend across the upland portion of the area in a general north and south direction, and the intervening valleys are usually narrow and occupied by deep erosions or arroyos. A few of the larger valleys widen out in places, forming small, comparatively level areas almost entirely surrounded by the hills and ridges. Two of the valleys are several square miles in extent. The larger is located in the southeastern section of the area and is crossed by the eastern boundary line, while the other occurs in the extreme northeastern corner of the survey.

The surface of these valleys is not as level as that of the valley along the river. Low, gentle swells and shallow depressions occur frequently, causing the topography as a whole to be very gently undulating. Many small arroyos traverse these valleys, but the comparatively level topography prevents the land from becoming seriously damaged by erosion. The summits of the rounded hills and ridges often reach an elevation of more than 100 feet above the level of the river valley and the hillsides are often steep and eroded. The steeper slopes usually occur on the sides of the ridges which front the river or the larger arroyos. Here the soil is very shallow and stony and areas of rock outcrop occur frequently.

The Rio Grande is the only perennial stream and receives the drainage waters of every section of the district surveyed. Chacone Creek, a large intermittent stream, traverses the northern half of the area in a general northeasterly and southwesterly course and empties into the Rio Grande a few miles below the city of Laredo. The Arroyo Becerro rises in the south-central portion of the area, and following a general southerly course empties into the Rio Grande a few miles south of the area. There are also many small arroyos, or wet-weather streams, through which the drainage waters of the area reach the Rio Grande or one of the larger arroyos. These minor stream courses contain water only during times of heavy rainfall, and, with the exception of a few pools of standing water along the courses of some of the larger creeks, their channels remain perfectly dry during the greater part of the year.

It is estimated that about four-fifths of the present population of the area is of Mexican origin. The area was formerly under Mexican rule and many of the present inhabitants are descendants of the early settlers. Many have also come into the area during recent years and have become citizens of the United States. A large pro-

portion of the inhabitants who are of American origin have come into the area from the older States or from the more thickly settled districts of Texas during comparatively recent years. This is mainly due to the fact that this section of the State was formerly devoted exclusively to the raising of cattle, and its agricultural development has only been attempted during recent years. The area as a whole is very thinly settled. The valley lands along the Rio Grande, both north and south of the city of Laredo, have been improved and cultivated during the last decade, and this section of the area is at present comparatively thickly settled. In the rolling upland section of the eastern part of the area, however, there are very few settlers, the land has not been developed agriculturally, and the cattle ranches are usually many miles apart. This rolling section is inhabited mainly by Mexicans, who care for the herds of goats and cattle and attend to the fences on the larger ranches.

Laredo is the only city within the boundaries of the survey. It has a population of about 14,000 and is located on the Rio Grande River near the center of the western boundary line of the area.

The International and Great Northern Railroad and the Texas Mexican Railway furnish adequate facilities for transporting the products of the area to the eastern and northern markets. The Mexican National Railroad connects the area with all the principal cities of Mexico, and the Rio Grande and Eagle Pass Railway, which extends from Laredo to Minerva, 28 miles up the valley of the Rio Grande, is also of considerable local importance.

Laredo is the local market for all the products of the area. The onions grown in the valley of the Rio Grande are shipped to the northern markets. Many are shipped to Galveston by rail and then by boat to the larger markets. The cattle are shipped to Fort Worth, Tex., St. Louis, Kansas City, and Chicago. The wool is usually shipped via Galveston to the large eastern markets.

CLIMATE.

The climate of the area is semiarid. The winters are mild and dry, and the strong breezes from the Gulf prevent the heat of the summer becoming oppressive.

The average temperature for the entire twelve months of the year is 72.4° F. The larger part of rainfall occurs in the months of April, May, August, and September, during which the normal monthly precipitation is more than 2 inches. The normal annual precipitation is 17.80 inches, but the great evaporation that takes place in this climate allows the soil to retain very little moisture and irrigation is necessary in order to cultivate the land with any certainty of securing profitable yields.

The following table, compiled from the records of the Weather Bureau, gives the normal monthly and annual temperature and precipitation, as observed at Fort McIntosh, which is located at Laredo:

Normal monthly and annual temperature and precipitation.

Month.	Fort McIntosh.		Month.	Fort McIntosh.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F	*Inches.*		°F.	*Inches.*
January	55.9	0.89	August	86.8	2.45
February	60.1	.71	September	81.7	2.30
March	67.2	.86	October	73.6	1.42
April	74.8	2.06	November	62.7	.65
May	80.8	2.46	December	52.9	.78
June	85.3	1.85	Year	72.4	17.80
July	87.4	1.37			

The following table, compiled from the same source, gives the dates of the first and last killing frosts during the period 1898 to 1904. This table shows that there is an average season of more than nine months during which vegetation is never damaged by frosts:

Dates of first and last killing frosts.

Year.	Fort McIntosh.		Year.	Fort McIntosh.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1898	Mar. 3	Nov. 21	1902	Jan. 28	Nov. 27
1899	Feb. 15	Dec. 3	1903	Feb. 18	Nov. 27
1900	Feb. 18	Nov. 11	1904	Feb. 21	Nov. 11
1901	.....	Dec. 9	Average	Feb. 17	Nov. 24

AGRICULTURE.

The region in which the present survey was made was formerly one vast open range, utilized exclusively as pasture lands for stock, which were branded by the owners and allowed to roam. During the last fifteen or twenty years, however, a very large proportion of the grazing lands have been fenced off into pastures, until at the present time no open country or free pasture land remains in the district surveyed. The lands of the area were first owned as old land grants, called " porciónes," which consisted of narrow strips about one-half mile wide, extending from the Rio Grande back into the interior a distance of 18 miles. This division of the lands was made for the purpose of giving each " porción " an area bordering the river, where the stock could obtain water. Now, large tanks for catching and holding the flood waters at times of heavy rains have been constructed in the large pastures in the interior, and many wells have

also been dug during recent years, so that the ranchmen no longer depend entirely on the river as a source of water supply for the stock.

Small areas of the level valley along the Rio Grande were sometimes cultivated to corn or sorghum, but no serious attempt was made to develop the area agriculturally until about 1891, when a small area of the Laredo silt loam was irrigated and planted in grapes. The soil, however, was not well adapted to the production of grapes and the vines soon became diseased and failed to give profitable yields. Although the growing of grapes under irrigation did not prove a success, it suggested the agricultural development of the irrigable land, and a larger area was soon under irrigation and planted in early vegetables, especially tomatoes, which were to be put on the market early in January. This attempt was not an absolute failure, but the crops were frequently damaged by frosts, and the uncertainty of getting profitable yields early enough in the season caused this industry, also, to be abandoned. It was not until about 1901 that the Bermuda onion was first grown in the area, which crop has proved such a success that the development of the irrigable land along the river has progressed rapidly. At the present time a large proportion of the level lands bordering the Rio Grande are cleared of the native growth of mesquite and cactus, irrigated, and utilized mainly for the production of this variety of onion.

The raising of cattle, which are shipped to the northern markets, is still the principal industry, and since the open ranges have been fenced off into large private pastures more attention has been given to the improvement of the stock. The old breed of Texas longhorns has almost entirely disappeared, to be replaced by the Durham and other improved stock. Many goats are pastured on the more barren sections of the rolling uplands, where the gravelly hills and ridges support only a light growth of mesquite and cactus, making them very poor pasture lands for cattle.

There are very few sheep on the ranches within the boundaries of the area, but some of the ranches located in the county only a short distance from the area are stocked with large herds of sheep, and a considerable quantity of wool is exported annually.

The growing of onions has developed so rapidly within the last few years that this crop is now one of the most important products of the area. The onion crop has never been a failure since its introduction in the area, but the profits realized from this crop depend largely on the condition of the market. It is estimated by those engaged in this industry that a carload of 24,000 pounds can be marketed at an average profit of $300. Much larger profits, however, have been obtained from carloads when marketed under very favorable conditions. The onion seed are first sown in small beds, about the latter part of September, and are immediately irrigated. As soon

as the young plants come up they are irrigated and cultivated until the latter part of November, when they are transplanted in the fields prepared for them. The crop is then carefully cultivated and irrigated on an average of once in every ten days until it matures. The harvesting begins early in May and continues until the latter part of June. A few sweet potatoes, cabbage, and other vegetables are grown under irrigation for the local market, but the acreage cultivated to these crops is very limited and none are shipped to the more distant markets.

Sorghum is grown as a forage crop on the unirrigated land, and the acreage of this crop is steadily increasing. Cotton has been grown to a very limited extent, both on the irrigated and unirrigated lands. The healthy growth of the plants promised large yields, especially on the irrigated areas, but the crop was always partially or totally destroyed by the boll weevil.

The area has been developed agriculturally to such a limited extent and the improved lands have been under cultivation for such a short time that, as yet, there is very little recognition of the adaptation of any of the types of soil to certain crops.

The sandy phase of the Laredo silt loam, which occurs nearest the present channel of the river, and the Webb fine sandy loam are recognized as being better adapted to the production of sweet potatoes than the soils of heavier texture. Very limited experiments have indicated that the irrigated areas of Webb fine sandy loam will produce a fair grade of tobacco, and there is a probability of this crop eventually becoming an important product of the area. Very profitable yields of onions are secured from all three of the soil types under irrigation, but the Laredo clay loam and Webb fine sandy loam seem slightly better adapted to this crop than the Laredo silt loam, and under ordinary conditions the first two types produce a larger yield per acre. If heavy rains occur during the harvesting season, however, the crop grown on the Laredo clay loam is damaged by the water which collects in the depressions.

The only rotation of crops practiced in the area is the growing of cowpeas on the land cultivated in onions. As soon as the onion crop is harvested the land is sown in cowpeas, which are usually plowed under in the fall when the fields are being prepared for the planting of the new onion crop. The growing of cowpeas on these soils has proved very effective in keeping them in a productive state.

The laborers employed on the farms and ranches consist almost entirely of Mexicans. This class of labor is very plentiful, but as a rule it is not very efficient and requires close supervision. With very few exceptions the foremen and managers on both the cattle ranches and onion farms are Americans. Laborers are usually hired by the day at wages ranging from 50 to 75 cents. The women and boys em-

ployed on the onion farms usually receive less. A few laborers are employed by the month on some of the larger ranches and are paid $15 to $20 a month with board.

Almost all of the cultivated land is farmed by the owners, but most of the larger cattle ranches are owned by persons who live in the city or by companies and are in charge of a foreman or manager. Very little land is rented either for agricultural purposes or for stock raising. A small acreage of the irrigated land along the Rio Grande has been rented for the growing of onions, the rental paid being about $50 an acre, including water for irrigation purposes.

According to the Twelfth Census, the average size of the farms in Webb County, including stock ranches, is 3,035 acres. Some of the stock ranches contain a larger acreage, but the development and irrigation of the lands along the Rio Grande has resulted in many small farms in this section of the area. Some of the irrigated farms, however, are a part of the large ranches which extend for some distance back into the rolling uplands. The small level areas bordering the river are cultivated, while the remainder is utilized as pasture land for stock. The number of acres in each farm cultivated to onions seldom exceeds 15 or 20, but there is usually a small acreage of the irrigation land planted in other crops.

The agricultural development of the area has greatly increased the value of the irrigable land. Land which could be bought for very little a few years ago is now valued at more than $100 an acre, and at present none of the irrigated farms are for sale. The value of the irrigable land which has not yet been developed depends largely on its distance from the city, its nearness to the river, and the difficulties to be overcome in putting it under irrigation; but the average price is estimated to be from $20 to $30 an acre. The rough and hilly sections, which are used only as pasture lands, are valued at about $1.50 to $2 an acre.

Where crops are grown without irrigation, those methods of cultivation should be practiced that will aid in the conservation of the soil moisture. The land should be plowed deep and all crops given level cultivation. A very shallow cultivation after each rainfall, so as to form a dust mulch on the surface of the soil, is a very important factor in retaining moisture in the soil.

SOILS.

The soils encountered in the Laredo area may be separated broadly into two classes. First, those derived from the material which has been deposited in the valley of the Rio Grande during comparatively recent times; second, those occupying the hills and narrow valleys of the remainder of the area, and derived mainly from deposits of sand and sandy clays laid down over the underlying formations of sandstone and shale at an earlier geological period. The soils of this

latter division cover about four-fifths of the entire area surveyed, and consist of fine sand, fine sandy loam, a heavy silty clay, and a fine sandy loam containing a large percentage of rounded waterworn gravel.

The entire area is underlain by a fine-grained gray to brown sandstone. The strata of this formation vary from a few inches to several feet in thickness, and large concretions of iron are frequently found embedded in them. This sandstone is underlain by an argillaceous blue shale, which is sometimes exposed on the steeper hillsides and in the deeper arroyos. Although none of the soils in the area owe their origin wholly to the decomposition of these formations, both the sandstone and shale weather rapidly on exposure, and in some localities have entered into the formation of the soils to a considerable extent. The sandstone strata outcrop frequently on the steeper hillsides in the rolling upland sections and weather rapidly into a reddish-brown fine sandy soil. This fine material is easily eroded and is washed down to the lower levels, where it aids in the formation of the fine sandy loam that occupies the gentle slopes and shallow valleys of this section of the survey. The red or brown color of the material formed from the decomposition of this sandstone is due to the large amount of iron it contains. The depth of the deposit of fine sand and sandy clays, from which the larger proportion of the upland soils is derived, depends largely on the topographic position of the area it occupies. On the more level areas and in the shallow valleys this formation covers the underlying sandstone to a depth of many feet, but on the steeper slopes of the hills and ridges it has been eroded to such an extent that it is seldom more than a few feet in thickness and in many places the underlying rock is exposed on the surface.

The gravel found scattered over the surface of the rolling hills and ridges in all sections of the area surveyed represents the remains of an old deposit which once rested on the sand and sandy clays mentioned above. Beds of gravel several feet thick sometimes cap the summits of some of the higher elevations, but over the remainder of the area this deposit has been worn away and has become mixed with the sand and sandy clays, forming a soil which contains a large percentage of rounded, waterworn gravel. The texture of both the soil and subsoil of the fine sandy loam which occupies the narrow valleys and more level areas is similar to the texture of the fine earth of the gravelly loam occupying the hills and ridges, and the two types of soil are derived mainly from the same geological formation. The large amount of rounded gravel, however, which is mixed with the fine sandy loam of the uplands, together with the rolling topography of the gravelly type, makes a great difference in the agricultural value of the two soils and has caused their separation into two distinct types.

The texture of the soil which occupies the two broad valleys located in the northeastern and southeastern parts of the area is also a fine sandy loam, but it differs from the soil found in the small, narrow valleys in color, depth, topographical features, and agricultural value, and has been classed as a separate type. Two of the soils which occupy the level areas bordering the Rio Grande are closely related. The greater part of the material deposited along the old flood plain of the river is of a light, silty texture, but shallow depressions occur in some localities in the river valley, where water collects after heavy rains and where the fine particles of silt and clay have been washed in from the adjacent lands and redeposited. The texture of the soil in these depressions is heavier than that of the greater proportion of the soils formed from these recent alluvial deposits, and there is usually a larger amount of organic matter present. That portion of the level valley of the Rio Grande which lies between the silty deposits bordering the river and the rolling uplands is occupied by a fine sandy loam similar in texture and derivation to that found in the smaller valleys of the eastern four-fifths of the area.

The soils of the area vary in texture from a light, incoherent sand to heavy silty clays. They have been separated into seven distinct types, the separation being based mainly on the texture of both soil and subsoil to a depth of 3 feet. The presence of rock or gravel on the surface, conditions caused by erosion, or the depth of soil and subsoil, also cause them to be vastly different in agricultural value. Several of the soils mapped in this area are quite similar in texture and derivation to soils which are very profitably cultivated in other sections of the Gulf coastal plain, but their dry, compact condition in this semiarid region, the fact that irrigation is necessary to cultivate them properly, and the general lack of agricultural development in the whole area give to these soils a much lower value at the present time than is the case with similar soils in regions of greater rainfall.

The following table gives the name and extent of each type of soil mapped in the survey:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Webb gravelly sandy loam...	53,760	54.0	Laredo clay.....	768	0.8
Webb fine sandy loam.....	21,248	21.4	Laredo clay loam.....	704	.7
Brennan fine sandy loam.....	11,584	11.6	Total.....	99,520	.....
Laredo silt loam.....	8,320	8.3			
Webb fine sand.....	3,136	3.2			

WEBB GRAVELLY SANDY LOAM.

The soil of the Webb gravelly sandy loam consists of a light-brown to reddish-brown fine sandy loam, carrying a large quantity of rounded, waterworn gravel. The soil has an average depth of about 10 inches, but on the steep hillsides the fine sandy loam is easily eroded and is seldom more than a few inches deep. When this finer material is washed down to the lower levels, the rounded gravel left on the steep slopes frequently covers from 40 to 60 per cent of the surface. The subsoil consists of a very sandy clay, brown to reddish-brown in color. The subsoil contains a large percentage of sand, but is sticky and tenacious when wet, and in small areas on some of the steeper slopes, where it has become exposed by the erosion of the upper soil, its surface is baked and sun cracked and has the general appearance of a much more clayey material.

The gravel content of the Webb gravelly sandy loam often varies considerably in areas of only a few square rods in extent. A large part of the surface on the summits and steeper slopes of the higher hills and ridges is covered by rounded gravel, but small areas, only a few acres in extent, often occur in these rolling uplands which contain little or no gravel either on the surface or in the soil. These small areas, however, are so intermingled with small gravelly areas that the surface of some of the hillsides is alternately gravelly or free from gravel, and it was found impracticable to attempt their separation in mapping.

The Webb gravelly sandy loam covers a very large proportion of the total area surveyed. It occupies the rolling uplands which extend from the northern to the southern boundary of the survey in an almost unbroken series of rounded hills and narrow ridges. Some of these hills reach an elevation of more than 100 feet above the level of the river valley, and the intervening valleys are narrow and occupied by deep arroyos. The topography of this section is very rolling, but is seldom rough and broken. The hillsides are usually not very steep, except those bordering the valleys of the streams and larger arroyos, which are frequently steep and eroded. The rolling uplands are underlain by a fine-grained sandstone, which has been covered by the more recent deposits of sandy clay, fine sand, and gravel. The soil is derived mainly from the fine sand and sandy clay formations, but the sandstone outcrops frequently along the steep hillsides and weathers rapidly into a red or brown very fine sand, which has entered largely into the composition of the soil. The gravel content of the soil is derived from the remains of an older deposit that once probably covered a larger percentage of the surface of the entire area, but which has since been worn away by erosion, until the deeper deposits of gravel only occur in small areas capping the summits of the higher elevations.

The Webb gravelly sandy loam supports a heavy growth of mesquite and cactus and also a fairly good growth of native grasses. It is not well adapted to agricultural purposes, as it would be impracticable to attempt its irrigation. The gravelly texture of the soil and its rolling topography make it better adapted to the growing of fruit than to the production of any crops which would require the cultivation of the soil. None of this soil is under cultivation at the present time, it being used exclusively as pasture land for cattle and goats. It is valued at about $2 an acre.

The following table gives the average results of mechanical analyses of fine earth of this type of soil:

Mechanical analyses of Webb gravelly sandy loam.

No.	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.*
16264, 16268	Soil	0.5	0.7	0.8	23.3	41.8	25.1	7.8
16265, 16269	Subsoil	.6	.8	.5	7.9	23.3	52.3	14.7

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16269, 1.82 per cent.

WEBB FINE SANDY LOAM.

The soil of the Webb fine sandy loam is a light-brown to reddish-brown fine sandy loam with an average depth of 10 to 12 inches. A few rounded gravel are sometimes found scattered over the surface or mixed with the soil, but the type as a whole is generally free from gravel or rock fragments and is very uniform in texture, color, and general topographic features. The subsoil consists of a very sandy clay which varies from brown to reddish brown in color. The upper part of this subsoil contains a considerable amount of fine sand and has the characteristics of a very heavy, sticky, sandy loam, but it becomes heavier as the depth increases and at 18 to 20 inches is a compact sandy clay, sticky and tenacious when wet, but still containing a large percentage of medium and fine sand.

The Webb fine sandy loam supports a very heavy growth of cactus and mesquite, but when cleared of this native vegetation the fine sandy texture of the soil makes it easy to cultivate, and the heavier subsoil enables it to conserve more moisture than the light silty soils along the river. For this reason the crops grown on the irrigated areas of this type do not require as much water as those grown on the soils underlain by a lighter-textured subsoil. The type is found occupying narrow valleys and more level areas in all parts of the area surveyed. It also occurs in that portion of the Rio Grande Valley that lies between the silty deposits bordering the stream and the foothills of the rolling uplands. The surface of the type is usually

almost level or very gently undulating. The narrow valleys slope gently toward the small arroyos which traverse them, and although these small wet-weather streams have cut deep, narrow channels through the underlying sandy clay, the type as a whole has not been damaged to any extent by erosion.

The Webb fine sandy loam is derived partly through the weathering of the deposits of fine sand and sandy clay which cover the older geological formations over the greater proportion of the area, and partly from material derived from the same source, which has been worked down from the steeper slopes of the hills and ridges at times of heavy rains and redeposited in the narrow valleys or on the more level areas at the foot of the slopes. In some localities the underlying sandstone outcrops along the steeper hillsides and the fine sand resulting from its disintegration has been washed down to the lower levels and aided in the formation of this type.

Small areas of the Webb fine sandy loam occurring along the outer edge of the Rio Grande Valley near the base of the rolling upland have been put under irrigation, and small unirrigated areas are cultivated in various parts of the area surveyed. The soil is productive and under irrigation gives very profitable yields of all the crops suited to the climatic conditions of the area. The irrigated land is used mainly for growing onions and seems well adapted to this crop, the average yield being about 20,000 pounds per acre. Under favorable conditions yields of more than 25,000 pounds per acre have been obtained. Cabbage, turnips, and beets have been grown to a very limited extent on the irrigated land. A few fruit trees planted on this type in recent years are in good condition, and seem to do better than on the soils of a more silty texture. Sweet potatoes have been grown to a very limited extent on the irrigated areas, the average yield being about 150 bushels per acre. Cowpeas do well both on the irrigated and unirrigated areas. Small areas, seldom more than a few acres in extent, are cultivated without irrigation in many parts of the area surveyed, and during a very favorable season a fair yield is obtained from the crops grown. Corn, when not irrigated, seldom produces more than 10 to 15 bushels per acre, and the yield is uncertain during a dry season. Sorghum is grown for feed purposes and does fairly well without irrigation. Some tobacco has been successfully grown, a good quality of leaf being produced, and this soil seems adapted to this crop. A very large percentage of this type of soil is still undeveloped agriculturally and is used as pasture land for cattle and goats.

The average results of mechanical analyses of the fine earth of this type of soil are given in the following table:

Mechanical analyses of Webb fine sandy loam.

No.	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.*
16272, 16276.....	Soil	0.1	0.3	0.4	17.4	46.3	22.3	13.1
16273, 16277.....	Subsoil.....	.3	.3	.3	13.4	39.9	24.3	21.0

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$) : No. 16273, 1.27 per cent.

LAREDO CLAY.

The surface soil of the Laredo clay, to an average depth of about 10 inches, consists of a light-brown to drab clay loam. The upper 2 or 3 inches of the soil often contains enough fine sand to give it a slightly gray appearance, but the soil becomes stiff and heavy at a very slight depth, and at 6 to 10 inches it contains little or no fine sand. The soil is underlain, to a depth of 3 feet or more, by a light-brown to drab clay, stiff and heavy, and in the lower part of the 3-foot section so dry and compact that it is difficult to penetrate with a soil auger.

The type occurs in a small area, about 1 square mile in extent, in the northeastern section of the survey. The topography is comparatively level, but the area is partly surrounded by the rolling upland and there is a gentle slope from the base of the hills and ridges toward Chacon Creek.

The Laredo clay is formed from the redeposition of the finer material held in suspension by the waters of Chacon Creek and laid down over this level area during times of overflow and from the finer particles of silt and clay which have been worked down from the neighboring hills and ridges.

None of the type is under cultivation at the present time, but the dense growth of mesquite and other native vegetation which it supports indicates that it is productive and free from any harmful accumulations of alkali. The topographic position of this type causes it to receive the drainage waters from the surrounding hills, and the heavy clay subsoil is well fitted to maintain a supply for plant use. This keeps the soil in a fairly moist condition, and it could probably be profitably cultivated without irrigation except during extremely dry seasons. At the present time, however, it is utilized exclusively as pasture land for stock and is valued at about $2.50 an acre.

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

Mechanical analyses of Laredo clay.

No.	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.*
16288	Soil	0.0	0.5	0.1	4.3	17.0	33.7	45.0
16289	Subsoil	.1	.2	.1	4.0	16.8	35.1	42.9

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16288, 10.30 per cent; No. 16289, 9.54 per cent.

LAREDO SILT LOAM.

The Laredo silt loam, to a depth of about 12 inches, consists of a gray to very light-brown silt loam, which usually contains a considerable amount of fine and very fine sand in the upper 6 to 10 inches of the soil. The subsoil, extending from 12 to 36 inches, is composed of the same material as the soil, but usually contains less fine sand and is slightly lighter in color. The silty to very fine sandy texture of this soil makes it easy to cultivate, and the surface of the areas which have been plowed and used for agricultural purposes is friable and loamy. The surface of the unimproved areas, however, is very dry and compact and often has the general appearance of a soil of heavier texture.

The Laredo silt loam occurs in one continuous strip, which borders the Rio Grande and extends along the entire western boundary of the area except in the extreme northwestern and southwestern corners, where the rolling hills extend down to the present channel of the stream. The topography as a whole is almost level. In many localities there is a narrow strip of this soil along the present channel of the river, and the rise to the broad valley occupied by the greater proportion of this type is steep and abrupt. The upper terrace or main valley of the river often has a very gentle slope toward the rolling hills bordering the valley, and in places where it is traversed by the larger arroyos the topography of the adjacent land is often gently rolling. Because of its favorable position in the valley of the Rio Grande and almost level topography, irrigation is practicable over nearly all of the area of this type, and hence it is one of the most valuable soils in the area surveyed.

The material from which the Laredo silt loam is derived is an alluvial deposit laid down in the valley of the Rio Grande at times of early floods. This deposit varies in depth from a few feet, near the outer edge of the valley, to more than 30 feet nearer the river, and the whole mass is very uniform in texture from the surface down to the stratum of fine-grained sandstone which underlies it. The soil which occurs near the river on the first or second terraces

usually contains a little larger percentage of fine sand than that which was laid down at a greater distance from the channel. This is due to the sorting power of currents of different velocities, the coarser material being laid down in the swifter water nearer the main channel of the river, and the larger percentage of silt and clay on the broad level valley where the movement was slower. Small accumulations of alkali are sometimes encountered on the surface of this soil, but these salts do not occur in sufficient amounts to be harmful to the crops grown, even in the slight depressions which have received the seepage waters from the areas under irrigation.

A comparatively large percentage of the type is cultivated and the greater proportion of the cultivated area is under irrigation. When irrigated it produces very profitable yields of all the crops grown, but on the unirrigated areas the yields are usually light and the crops are often a total failure. The light silty character of both the soil and subsoil makes it necessary to irrigate this type more frequently than in case of soils which have a heavier subsoil and for the same reason the unirrigated areas are more easily affected by droughts.

The type seems well adapted to the production of onions and a very large proportion of the cultivated land is used for this crop. The average yield has been estimated at about 18,000 to 20,000 pounds per acre, but during a very favorable season 25,000 pounds per acre has been secured. Cotton has been grown under irrigation. Although a very fine growth was obtained, the crop was totally destroyed by the boll weevil. Sweet potatoes are grown very successfully and have produced yields of 150 to 200 bushels per acre. Sweet potatoes, however, require a large amount of water and it has been found necessary to irrigate them very frequently in order to get the best results. The lighter phase of the Laredo silt loam, which occurs near the banks of the river, seems especially well adapted to this crop. Some corn has been grown on the irrigated land and produced a yield of about 40 bushels per acre. On the unirrigated land, however, corn is very uncertain and seldom yields more than 12 to 15 bushels per acre. Cabbage has also been grown to a very limited extent on irrigated land and produced about 13,000 pounds per acre. Beets and turnips do exceedingly well, and when irrigated and properly cultivated fair yields of Irish potatoes have been obtained. Alfalfa is grown under irrigation, but it does not do well for more than one season. Strawberries are very successfully grown on irrigated areas of this soil. A straw mulch, however, is laid over the beds to protect the plants from the heat during the summer months. Cowpeas do well on both the unirrigated and irrigated soil.

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The value of the Laredo silt loam varies considerably, according to the extent of improvements and its distance from the city of Laredo. The areas which have been developed agriculturally and put under irrigation are valued at $100 or more an acre, while the undeveloped land ranges in value from $20 to $35 an acre, according to its location in the area.

The average results of mechanical analyses of samples of the Laredo silt loam are given in the following table:

Mechanical analyses of Laredo silt loam.

No.	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.*
16278, 16280	Soil	0.1	0.3	0.6	8.9	32.8	43.7	13.9
16279, 16281	Subsoil	.1	.2	.3	8.0	36.9	39.1	14.5

The following samples contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16278, 10.35 per cent; No. 16279, 12 per cent; No. 16280, 10.80 per cent; No. 16281, 15.10 per cent.

WEBB FINE SAND.

The Webb fine sand, to a depth of about 12 inches, consists of a fine loamy sand of red to reddish-brown color. The upper 1 or 2 inches of the surface soil is usually a loose, incoherent fine sand, but the structure of the soil as a whole is very compact. The surface soil grades into a subsoil which is quite similar both in color and texture, though it usually becomes more loamy in the lower part of the profile, and from about 20 to 36 inches is a very light sandy loam of a red to reddish-brown color.

Two small areas of the Webb fine sand occur in the northwestern part of the survey. They occupy comparatively level or gently rolling country in the uplands, and often have an elevation of 50 feet or more above the level of the stream valleys. The soil is easily eroded, but the slopes of the low hills are seldom steep and the type as a whole has not been damaged by erosion to any great extent. The underlying sandstone is often encountered near the surface, but it seldom outcrops, except in very small areas occurring along the hillsides facing the river or some of the larger arroyos.

The Webb fine sand is derived mainly from the weathering of the underlying fine-grained sandstone, and its red color is probably due to the large amount of iron contained in this formation. The deposit of fine sand and sandy clay, which usually overlies the sandstone, has also probably entered into the composition of this type to a limited extent. The sandstone strata are frequently encountered at a depth of 3 to 5 feet below the surface on the low, rounded elevations, but on the more level areas the soil is usually much deeper.

The native vegetation consists mainly of cactus and mesquite, and the growth is heavier than that found on the gravelly hills and ridges. The soil also supports a heavy growth of native grasses, causing it to be classed among the best pasture lands of the area. At the present time none of this type of soil is under cultivation, being used exclusively as grazing land for cattle.

The results of mechanical analyses of this type of soil are shown in the following table:

Mechanical analyses of Webb fine sand.

No.	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.*
16270	Soil	0.1	0.7	0.7	34.3	41.9	14.2	7.6
16271	Subsoil	.3	.6	.7	30.6	43.4	11.0	13.9

LAREDO CLAY LOAM.

The soil of the Laredo clay loam, to an average depth of 10 or 12 inches, consists of a heavy light-brown silty loam, which contains enough clay to make it sticky and tenacious when wet and to cause it to bake and sun crack on drying. This soil grades into a brown silty loam of slightly heavier texture, which rapidly becomes heavier as the depth increases, until at an average depth of about 20 inches it changes to a stiff, compact, silty clay of a dark-brown color.

The Laredo clay loam, though of very limited extent, is considered one of the most productive soils in the area surveyed. The surface soil, when properly cultivated, breaks up into a loamy, friable condition, the heavy subsoil is retentive of moisture, and the effects of fertilizers are lasting.

The type occurs in two narrow strips, seldom more than a quarter of a mile in width, which are located in the valley of the Rio Grande. One is situated in the northwestern part, a few miles north of the city of Laredo, and the other in the extreme southwestern part of the area surveyed. These two narrow strips extend along the valley in a general north and south direction, following closely the general course of the present channel of the river. In some localities in the Rio Grande Valley the alluvial deposit along the river slopes gently back toward the rolling uplands, and where this meets the gentle slope which extends toward the river from the base of the rolling hills and ridges, shallow depressions are formed which are occupied by this type of soil. The surface of these depressions, however, is almost level, and although they receive the drainage waters from the areas surrounding them at times of heavy rains, the level topography prevents the soil from becoming seriously damaged by erosion.

The Laredo clay loam is an alluvial soil formed from material deposited in the old flood plain of the Rio Grande. The depressions in which the type is found probably remained in a wet and flooded condition for some time after each overflow, and the finer particles of silt and clay, held in suspension by the waters of the river, were slowly deposited in these areas of standing water, forming a heavier soil than that derived from the material which was laid down nearer the channel of the stream. At times of heavy rainfall these areas are still partly flooded, and the finer material washed down from the adjacent slopes is redeposited in them.

A large percentage of the total area of this type of soil is under cultivation, and the greater proportion of the cultivated area is irrigated. The location of the land in the river valley, together with its level topography, makes the cost of irrigation comparatively small. The crops grown are sometimes damaged by the water which collects in the depressions after heavy rains, but under ordinary conditions very profitable yields are always secured on the areas under irrigation. A small amount of alkali is found in this soil, but it does not occur in amounts sufficient to affect seriously the crops grown.

This soil is well adapted to the production of onions, which are grown under irrigation. The average yield is about 20,000 pounds per acre. If, however, heavy rains occur about the harvest season, the water, which collects in the shallow depressions occupied by this soil, damages the crop to a considerable extent. Alfalfa has been grown to a limited extent on the irrigated areas, and although a very fair stand is usually obtained, it does not thrive for more than one year. Cabbage and beets have also been very successfully grown, but Irish potatoes do not do well. Corn has not been grown on the irrigated areas, but has produced yields of from 15 to 20 bushels per acre on unirrigated land. With irrigation there is no doubt much larger yields could be secured. Sorghum has been grown for feed purposes on the unirrigated soil and produced very fair yields. Cowpeas do exceedingly well on both the irrigated and unirrigated land, and where this crop has been grown and turned under the physical condition and general productiveness of the soil have been greatly improved. Sweet potatoes have been grown under irrigation with very good results, producing an average yield of about 150 bushels per acre.

The areas of this type of soil which have been improved and put under irrigation are valued at more than $100 an acre. The remainder of the type is valued at from $20 to $30 an acre.

The following table gives the average results of mechanical analyses of typical samples of the Laredo clay loam:

Mechanical analyses of Laredo clay loam.

No.	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.*
16284, 16286.....	Soil	0.0	0.4	1.9	15.8	15.9	32.8	32.9
16285, 16287.....	Subsoil.....	.2	.2	1.5	12.7	14.1	28.3	42.2

The following samples contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16284, 6.36 per cent; No. 16285, 15.05 per cent; No. 16286, 7.26 per cent; No. 16287, 10.08 per cent.

BRENNAN FINE SANDY LOAM.

The soil of the Brennan fine sandy loam to an average depth of about 12 inches consists of a heavy fine to medium sandy loam of a gray to very light-brown color. The subsoil consists of a heavier brown sandy loam containing a larger percentage of silt and clay and becoming heavier as the depth increases, until in the lower part of a 3-foot section it contains enough silt and clay to make it plastic and sticky when wet, and to give it the characteristics of a very sandy clay. The lower portion of the subsoil is hard and compact and is usually so dry that it can be crushed into a fine powder, but when wet it becomes stiff and plastic, and the large content of silt and clay is very noticeable. When cleared of the thick growth of mesquite and cacti which it supports, the soil is easily cultivated and put in fine tilth.

The Brennan fine sandy loam occurs in two large, irregular-shaped valleys, each of which embraces an area of several square miles. One of these areas is located in the extreme northeastern corner of the survey, while the other extends for some distance along the southeastern boundary line. The topography is level to very gently undulating, and although small arroyos, or wet-weather streams, frequently occupy the shallow depressions the soil is never seriously damaged by erosion.

This fine sandy loam is formed mainly from the weathering of an old deposit of fine sands and sandy clays which, in these level sections of the eastern part of the area, cover the underlying sandstone to a considerable depth. A part of the material forming this soil, however, has been washed down from the rolling uplands and redeposited in these broad valleys.

None of the type is under irrigation, and only a very limited acreage is cultivated. As no irrigation is practiced, profitable crop yields are very uncertain. During a very favorable season, however, fair yields of cowpeas, corn, and sorghum have been obtained. A small acreage was planted to cotton during the present season (1906),

but although the plant grew exceedingly well the crop was destroyed by the boll weevil before it matured. Though the yield of corn is very light, two crops have been harvested in one season from a single field. Sorghum has been grown for feed purposes with very fair results. The greater proportion of the Brennan fine sandy loam is utilized at the present time as pasture land for stock, the heavy growth of native grasses and other vegetation which it supports causing it to be rated high as grazing land.

The average results of mechanical analyses of samples of this type of soil are given in the following table:

Mechanical analyses of Brennan fine sandy loam.

No.	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.*
16290, 16292.....	Soil	0.1	0.4	1.3	40.1	15.3	19.0	23.2
16291, 16293.....	Subsoil.....	.1	.3	1.5	50.4	9.2	15.2	23.6

The following samples contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16291, 1.77 per cent; 16293, 1.02 per cent.

IRRIGATION.

Irrigation is necessary on every type of soil in the area surveyed, in order to cultivate it with any certainty of securing profitable yields from the crops grown. The water for irrigation purposes is obtained from the Rio Grande, and although it contains considerable soluble salts the quantity of harmful salts is not sufficient to have an injurious effect on the land, and this is especially true where the land is naturally well drained.

The following is an analysis of the water of the Rio Grande obtained from officials of the Rio Grande and Eagle Pass Railroad:

Analysis of Rio Grande water.

Matter in solution.	Grains in U. S. gallon.
Calcium carbonate	7.00
Calcium sulphate	17.68
Magnesium chloride	5.94
Sodium chloride	18.91
Sodium sulphate	13.06
Total	62.59

The second or upper terrace of the river valley, which embraces the greater proportion of the irrigable lands, usually has an elevation of 50 feet or more above the level of the river, and the water for irrigation purposes is pumped to the level of these lands through large iron pipes. The pumping stations are small and are located along the river. The water is pumped directly to flumes or ditches,

which distribute it over the area under irrigation. In some localities, where the irrigated land is located near the foot of the rolling uplands, a second lift of the water is necessary, in which case the water is first raised to a small reservoir, from which it is pumped to the highest point in the area to be irrigated and then distributed over the fields by means of ditches and flumes.

At the present time there are 1,500 acres of land under irrigation in the valley of the Rio Grande, of which 1,100 acres are utilized for the growing of onions. There is also a small irrigated area, several acres in extent, which is located in a small valley of the rolling upland section of the survey. The water for irrigating this land is obtained from a large tank, which catches the flood waters from the surrounding hills at times of heavy rainfall. A small gasoline engine pump is then used to force the water up to the ditches which distribute it over the fields.

Only about one-sixth of the irrigable land bordering the Rio Grande has been developed agriculturally, and some of the smaller valleys which extend back into the foothills of the rolling uplands can also be irrigated with water obtained from this river.

If reservoirs and tanks were constructed along the courses of some of the larger arroyos and intermittent creeks to catch and hold the flood waters, a considerable proportion of the contiguous level valley lands could be irrigated and profitably cultivated. No artesian wells occur within the boundaries of the area surveyed, and the water from the deep wells which have recently been sunk in various localities of the area is usually very salty. The water from a few of these wells, however, is comparatively free from alkali and could be used to irrigate small areas of the level valley lands.

The local method of irrigating consists of checking off the fields into small beds, each of which is surrounded by a low ridge about 1 foot in height. This forms each bed into a very shallow basin or reservoir, which is usually about 15 feet broad, but varies in length according to the topography of the field. The water, which is distributed over the fields in shallow ditches, is turned into each of these shallow basins and allowed to flood them.

The cost of irrigation depends largely on the position of the land in the river valley, the amount of leveling required, and on whether the water must be pumped or can be carried in flumes to the point from which it is distributed over the fields. The land which is located near the bank of the stream can usually be irrigated at a comparatively small cost, but where a second lift of the water is necessary the cost is much greater. The expense is reduced where the position of the irrigated area is such that the water can be carried in flumes to the points of distribution instead of being pumped the whole distance through iron pipes.

The average cost of establishing a system of irrigation on the land bordering the Rio Grande is said to be approximately $40 an acre. This cost includes pumping station, piping, flumes, the leveling of the land, and the construction of the ditches. After the soil is once under irrigation the cost of irrigating an onion crop during an entire season, including the cost of the fuel for the pumping stations and for labor, is estimated at about $18 an acre.

The agricultural development of the area depends largely on the development of the irrigable land. During recent years the acreage under irrigation has been steadily increasing.

SUMMARY.

The area surveyed is located in the southern part of the State of Texas and embraces 155.5 square miles of the southwestern portion of Webb County. The topography of the greater proportion of the area is quite rolling and the land is of small agricultural value. The broad valley of the Rio Grande, which forms the greater part of the western part of the survey, is comparatively level, and other smaller level valleys border the larger creeks and arroyos.

The Rio Grande is the only stream in the area which contains water during the whole year. There are many large, dry stream courses which traverse various sections of the area and serve to carry off the flood waters at times of heavy rainfall. The largest of these are the Chacon Creek and Arroyo Becerro. All the drainage of the area eventually reaches the Rio Grande.

About four-fifths of the population are of Mexican origin. The American population has increased since the beginning of irrigation. The eastern part of the area is very thinly settled, the cattle ranches are usually many miles apart, and considerable areas of the rolling uplands are inhabited only by a few Mexican goatherds.

Laredo is the only city within the boundaries of the survey. It has a population of about 14,000 and is situated on the Rio Grande. It is the local market for all the products of the area, but the onions and cattle are shipped to the larger northern markets. The International and Great Northern, the Texas Mexican, the Mexican National, and Rio Grande and Eagle Pass railroads furnish excellent transportation facilities for the entire area.

The climate of the area is semiarid. The normal annual precipitation is 17.80 inches, while the average temperature for the entire year is 72.4° F.

The area was formerly a vast open cattle range. Now the land is fenced into private pastures. The old breed of long-horned cattle has been replaced by more improved stock.

Agricultural development began about 1891 when a little land next to the river was irrigated. The Bermuda onion was introduced about 1901 and the growing of this crop under irrigation marked the real beginning of profitable agriculture. Cattle pastured on the hilly lands and onions grown along the river are at present the principal products. Tobacco has been successfully grown on the Webb fine sandy loam, which seems well adapted to the crop.

No systematic rotation of crops is practiced, but many of the farmers grow cowpeas during the summer season on the soils which are later planted to onions.

Mexican labor is employed on both the farms and cattle ranches. The supply is adequate for present needs. The wages paid vary from 50 cents to 75 cents a day.

The average size of the farms in Webb County, including cattle ranches, as given by the United States census of 1900, is 3,035 acres, but since the land along the river has been improved and irrigated many small farms are found in this section of the area.

There are seven types of soil in the area surveyed. These vary in texture from a fine loamy sand to a heavy silty clay. The soils occupying the valley of the Rio Grande are derived from material which has been deposited by the stream and are usually of a silty texture. In the remainder of the area the soils are derived mainly from deposits of fine sand and sandy clays, but in some localities they are partly the result of the decomposition of the underlying sandstone formation. The soil found in the more rolling sections of the area usually contains a high percentage of rounded gravel.

The Laredo silt loam and Laredo clay loam, which are alluvial soils occupying the river valley, have been developed agriculturally to a greater extent than any other types in the area. This is due to their location, which enables them to be irrigated at a comparatively small cost.

The Webb fine sandy loam is also cultivated to a limited extent. Small areas of this type which occur in the river valley are under irrigation, and other small areas, located in various parts of the survey, are cultivated without irrigation. A very small acreage of the Brennan fine sandy loam has been put under cultivation, but as no irrigation is practiced on this soil the crop yields are small.

The Webb gravelly sandy loam, Webb fine sand, and Laredo clay are not cultivated at the present time, being used exclusively as pasture land.

There are now 1,500 acres under irrigation in the valley of the Rio Grande, and a small area of 10 to 15 acres, located in a small valley some distance back from the river, is also irrigated. The water for irrigating the land bordering the Rio Grande is pumped from the stream to flumes or ditches which carry it directly to the fields to be

irrigated. The small area situated at a distance from the river is irrigated with water obtained from a tank which has been constructed so as to catch and conserve the drainage water from the surrounding hills.

Only a small percentage of the irrigable land of the Rio Grande Valley has been developed agriculturally, and many of the smaller valleys of the area could be profitably cultivated when water for irrigation purposes can be obtained, either from wells or from storage reservoirs.

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