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Albert D. Rosellini, Governor

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Water Supply Bulletin No. 11

A Preliminary Report on the Geology and Ground-Water Resources of the Sequim-Dungeness Area Clallam County, Washington

By
John B. Noble

Olympia, Washington

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FOREWORD

Since the turn of the century, the Sequim-Dungeness area has experienced a gradual transition from an economy based primarily upon lumbering and fishing to one of agricultural products produced on irrigated lands.

Naturally occurring surface-water supplies in the area, like most of Western Washington, are not in phase with agricultural demand; and as a result, the total amount of land that can be placed under irrigation is limited and coincides with minimum flows that occur in the area's streams. If the Sequim-Dungeness area is to continue to expand its agricultural economy, there must be additional water supplies made available through improved water use practices and development of additional water sources. The data presented herein have an economic value and were compiled for the purpose of assisting those associated with water resources development in making a complete and beneficial use of the total water supply of the area. Everything possible has been done to assure the completeness and accuracy of these data.

I respectfully submit herewith "A Preliminary Report on the Geology and Ground-Water Resources of the Sequim-Dungeness Area, Clallam County, Washington," by John B. Noble.

Robert H. Russell
Assistant Supervisor
Division of Water Resources

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A PRELIMINARY REPORT
ON THE
GEOLOGY AND GROUND-WATER RESOURCES
OF THE
SEQUIM-DUNGENESS AREA,
CLALLAM COUNTY, WASHINGTON

By John B. Noble

ABSTRACT

The Sequim-Dungeness area in the northeastern part of the Olympic Peninsula is composed chiefly of glacial outwash material graded from the Olympic Mountains to the Strait of Juan De Fuca. The area is in a rain shadow which allows an annual average precipitation of only 16.92 inches, but extensive irrigation permits the area to be a rich dairy center.

Topography within the project area is planar except where complicated by ice contact features and older stream terraces. The Dungeness River provides the largest single drainage channel--many smaller drainage ways, natural and artificial, also exist.

The area is developed primarily upon thick deposits of Pleistocene sands and gravels derived from recessional glacial outwash. Those outwash deposits that serve as aquifers are probably from Vashon age glaciation. Mixed with the permeable sand and gravel outwash are deposits of fine, impermeable material deposited as glacial lake deposits or as ground moraine. Some of the outwash material remains as it was originally deposited. Most of the outwash material has been re-worked by the Dungeness and neighboring streams as they carved surfaces graded from the mountains to a base level that has lowered at a non-uniform rate since Pleistocene time. As the base level lowered, downcutting streams left remnants of several terraces. Most terraces are mantled with thick silt deposits and have relatively higher altitudes--this combination requires deeper wells to penetrate the regional water surface. The surface graded to present sea level has a thinner mantle of fine materials and a relatively lower altitude such that shallower wells are possible.

Most wells tap unconfined ground water, but irregularly located impermeable deposits may cause local areas of confined ground water. Majority of ground-water recharge probably moves from the mountains, but local precipitation and losses from irrigation are also important factors. The recharge from irrigation is apparently responsible for the occurrence of highest water levels in summer. Artificial discharge has shown no apparent effect on the status of the water table.

Areas with surfaces graded directly to the Dungeness River and streams to the east are most productive of ground water. Water-logged areas also occur here and may perhaps be drained by pumping of large diameter wells. Happy Valley is an area which could possibly be developed by proper recovery of ground water. The northern and southern perimeter of the report area show the least likely spots for production of ground water.

Chemical analyses indicate hard but otherwise suitable water.

INTRODUCTION

Purpose and Scope of Investigation.

This investigation was made by the Division of Water Resources of the Department of Conservation as a part of a continuing program for the collection and interpretation of basic data concerning the ground-water supply of the State of Washington. The project was predicated by a number of requests for information pertaining to ground water by numerous individuals and agencies actively engaged in water resources utilization in the Sequim-Dungeness area.

The report was prepared under the general direction of Murray G. Walker, Supervisor, Division of Water Resources, Department of Conservation and under the direct supervision of Robert H. Russell, Assistant Supervisor. Work on the project was started in July, 1960 and completed in September, and required reconnaissance geologic mapping of the area, an interpretation of hydrologic and well record data and an evaluation of the effects of irrigation upon project lands. In presenting the material, the writer has directed his discussion toward the following conclusions: a determination of areas where appreciable amounts of ground water can be obtained to supplement irrigation district supplies from the Dungeness River, point out areas where new lands can be placed under irrigation utilizing ground water, and evaluate the feasibility of reclaiming water-logged lands by pumping shallow ground water for irrigation purposes.

Location and Extent of Area.

The Sequim-Dungeness area is a semi-ovoid landmass projecting into the Strait of Juan De Fuca in the northeast part of the Olympic Peninsula. It may be roughly considered to be a pediment carved upon glacial deposits that abut against the Olympic Range. The area chosen for this report includes the majority of the irrigable and arable lands; it is bounded on the north by the Strait of Juan De Fuca, on the east by Sequim Bay, on the west by Siebert Creek, and somewhat arbitrarily on the south by the 400 foot contour with the exception of the inclusion of Happy Valley.

The base map (pl. 1) used in this report is composed of parts of four U. S. Geological Survey 7½ minute quadrangles--the Dungeness quadrangle forms the northern part while the Sequim, Carlsborg, and Morse Creek quadrangles form the southern part of the area from east to west. Contour intervals on the maps are 20, 40, 40, and 50 feet, respectively.

The chief highway serving the area is U. S. 101, the Olympic Highway. Port Angeles, about 17 miles west of Sequim, is the nearest large center of population and is also located on U. S. 101.

Acknowledgments and Previous Investigations.

There has been no previous ground-water study made in the area. An intensive study of surface water and related irrigation supplies was made by the Bureau of Reclamation in 1950-51 to determine the feasibility of a government sponsored closed pipe distribution system for irrigation. No positive action was taken as a result of the report, but it does serve well for a detailed study of the irrigation system and requirements of the area.

A few well records and miscellaneous well data were available from water-right applications made to the Division of Water Resources. The majority of the well data was collected by Glen Holmberg of the Ground Water Branch, U. S. Geological Survey and the writer in the summer of 1960. Additional information was generously provided by Vernon Van Ausdle and Valler and Nick Stoican, all of whom are well drillers in the area. The greatest part of the information gathered was made possible only through the cooperation of the individual well owners.

To the best of the writer's knowledge there has been no detailed geology done concerning the glacial deposits which comprise the important water-bearing zones. Weaver (1937) and McMichael (1946) briefly describe the Tertiary rocks underlying the Quaternary sediments but within the confines of this report there is no water derived from Tertiary formations. An invaluable aid for mapping the geology was a collection of aerial photographs of the area provided by Allen D. Busenbark of the Soil Conservation Service in Port Angeles.

Several oil companies have carried on explorations in the area, and four generalized cross sections were prepared from shot hole logs released by Geophysical Surveys, Inc. made for Standard Oil Company of California for a seismic survey during the winter of 1954-55.

The writer wishes to expressly thank Mr. Allen D. Busenbark for his cooperation, and Mr. Glen Holmberg for field work, advice, and much additional information he was able to provide. He is also grateful to the aid provided in procedural suggestions by Robert H. Russell, Dee Molenaar, and other members of the Division of Water Resources.

Well Numbering System.

Well numbers used by the U. S. Geological Survey and the Washington State Division of Water Resources show locations of wells according to the rectangular system for sub-division of public land, indicating township, range, section, and 40-acre tract within the section. An example is the well numbered

30/3W-20C1 located west of Brown Road just northwest of Sequim. The part preceding the hyphen indicates successively the township and range (T. 30 N., R. 3 W.) north and west of the Willamette base line and meridian. The first number after the hyphen indicates the section (Sec. 20) within that township and the letter (C) gives the 40-acre sub-division of the section as shown in the diagram. The last number (1) is the serial number of the well in that particular 40-acre-tract and is the first well recorded there. The second well recorded would have the number 30/3W-20C2.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

GEOGRAPHY

Topography and Drainage.

The topography of the Sequim-Dungeness area is generally planar with a downward gradient of about 45 feet per mile toward the north. Terraces and hummocky areas of un-reworked glacial outwash deposits exist on the plain--these are discussed in more detail under "Geology." The topography has been carved by the numerous streams heading in the foothills or above and flowing roughly parallel to each other directly to the straits. The Dungeness River is the largest of these and provides the area with most of the irrigation water as well as providing municipal water for the town of Sequim.

Drainage within the report area is complex. A network of irrigation ditches and wasteways from the ditches act as artificial distributaries from the Dungeness and adjacent native streams. The ditches are controlled by four irrigation districts and seven or more private ditch companies. A comprehensive study of the surface waters was made by the Bureau of Reclamation (U.S.B.R., 1951). The irrigated lands as well as the ditches that serve them are important factors in the status of the ground-water table. Shallower wells reportedly have higher water levels in late summer after receiving the full effect of percolation of irrigation water. Some have gone dry in the winter months when precipitation is highest, but irrigation recharge is absent. The lowland surface streams are also reported to carry more water in summer than winter.

Climate.

The Sequim-Dungeness area is in a rain shadow thrown by the Olympic Mountains. The Dungeness River watershed receives fairly large (though specifically unknown) quantities of precipitation in the uplands. Precipitation rapidly decreases toward the coastal area.

The Sequim weather station reports average annual precipitation (terminating in 1959) to be 16.92 inches; December with 2.77 inches is the wettest month, and July with 0.55 inches is the driest. Average temperatures range from 37.7° in January to 60.7° in August with an annual average of 49.2° (U. S. Weather Bureau, 1960). There is a fairly high incidence of sunshine and a growing season of 194 days, but precipitation during the growing season is almost negligible.

Culture.

The climate, coupled with the extensive irrigation programs, serves to make the area one of the richest dairy centers in the State. Dairying is of primary importance but some crops are also grown. Logging plus an increasing tourist trade also figure as important facets of the economy. Sequim is the only incorporated town in the area--approximately one-third of the population resides there. Dungeness, Carlsborg, and Jamestown are the only other communities. Farming areas are located almost exclusively on the silt-mantled gravel plain graded to the Dungeness and its neighboring streams. A few of the areas of greater relief are farmed, but most remain forested due to poorer quality soils plus greater difficulty of irrigation.

GEOLOGY

The Sequim-Dungeness area is chiefly developed upon glacial outwash deposits from the Vashon age glacier at the close of the Pleistocene (Ice Age) epoch. The underlying Tertiary rocks crop out in beach exposures at Sequim Bay State Park on the east, and the junction of U. S. 101 and Siebert Creek on the west. A very general line between these points delineates the thick sequence of glacial outwash to the north from the glacial drift veneered foothills of the Olympic Mountains to the south.

Geologic History.

In early Pleistocene time the Olympic Mountains had probably been elevated to their present altitude. Then, as now, the northern front of the range was probably represented by the mountains rising south of Sequim and their outlier, Bell Hill. These mountains are composed of at least four sequences of folded and faulted sandstones, siltstones, and conglomerates ranging in age from Miocene through Eocene and resting upon or interbedded with Eocene submarine volcanics (Brown, et al, 1956). As far as is known, there are no acid igneous or coarsely crystalline metamorphic rocks native to the Olympics; therefore, outwash gravels were obviously derived from glacial materials carried from the north rather than from the present source of detritus to the south.

Since 1920, several test wells have been drilled by oil companies in the vicinity of Sequim. Their records show the Tertiary rocks to be very near the surface at the northern foot of Bell Hill, 2,105 feet below the surface just north of Gierin Hill, and 2,900 feet below the surface about one mile northwest of Jamestown.

The glacial activity responsible for the thick sequence of glacial outwash must have been exceedingly complex--an historical interpretation can only be a brief simplification. Three or more continental glaciers are believed to have advanced into Washington from the north during Pleistocene time. Within the report area the exposed sands and gravels deposited from glacial outwash are sound and unweathered which is typical of the latest or Vashon age glacial outwash. Earlier continental glaciers were quite possibly existent in the area, but neither outcrops nor well logs indicate definite evidence for pre-Vashon glaciation. Thus, the Vashon age glaciation is here considered chiefly responsible for the glacial geology of the area.

The Vashon age glacier flowed in a generally southward and westward direction to abut against the foothills of the Olympic Mountains. The topography over which this glacier advanced is unknown, but some semblance of a coastal shelf or plain derived from the ancestral Dungeness River probably existed. No till stratum is apparent from the glacier's advance, and the pre-Vashon surface must have been far below the present sea level. A well log from the Dungeness Lighthouse (31/3W-18F1) reports clam shells at 329 feet overlying clays and overlain by sands. This may possibly represent the surface just prior to the final glaciation, but it may also indicate a pause in the recession of the Vashon age glacier. The top of the consolidated Tertiary rocks is probably over 3,000 feet below this clam horizon; and the intervening sediments may be anything later than the uplift of the Olympics, probably during the Pliocene epoch.

Glacial erratics have been reported as high as 3,000 feet in the Olympics so the maximum extent of ice must have reached that altitude. During the earliest retreat of the glacier, the high relief prevented any accumulation of stratified outwash. Instead, a thin mantle of unstratified and heterogeneous material was deposited, probably as a ground and ablation moraine. This material merges indefinitely into the soils developed on the Tertiary bedrock to the south and into stratified recessional outwash to the north.

As the ice receded below the present 400 foot contour, relief became gradual enough that detritus derived from both ice front and foothills began to be laid down by the streams flowing from both directions. It is this material that comprises the great majority of the thick sequence of sands and gravels overlying the Tertiary bedrock. Outcrops of these sands and gravels occur along the sea cliff west of Dungeness and in road cuts and gravel pits throughout the area designated "Qg" on the geologic map (pl. 2). Bedding, grading, and sorting indicate extremely turbulent conditions of deposition. Single deposits of sand or gravel are seldom extensive. They pinch and swell rapidly or sharply abut against a second deposit in a cross-bedded attitude.

Well logs show frequent occurrences of "clay," "gravelly clay," and "hardpan." Pure clay was seen in outcrops at only two localities--a small deposit of blue clay on the sea cliff, and a very small exposure in a roadcut of U.S. 101 just east of McDonald Creek. The latter is a pale tan, pure clay that is probably composed of rock flour deposited in a temporary ice-dammed pond. Lakes and ponds must have been common during the ice retreat, and much of the clay reported in logs is probably of glacio-lacustrine origin. Other materials reported as clay may, in fact, be silts deposited from slower moving or flooded streams. The "gravelly clay" and "hardpan" may conceivably be of two origins: (1) Pure lake clays containing ice-rafted or otherwise introduced coarse detritus and (2) local areas of ground moraine (not a true till) probably laid down beneath the glacier during brief re-advances and (or) left as ablation deposits from a stagnant ice surface during retreats. Sections of these fine materials are shown in plate 3. Regardless of their origin, from a ground-water standpoint, these materials are nearly impermeable; they are non-productive but may serve as aquicludes above water-bearing materials and permit artesian pressures to develop.

The areas designated "Qg" on the geologic map represent materials left behind the retreating glacier and not re-worked by streams flowing from the Olympics. On the higher slopes to the south, this material is unstratified; to the north the majority is stratified outwash that was laid down in proximity to the glacier. The northernmost areas of "Qg" are excellent examples of ice contact features. They display erratic, hummocky topography with many closed depressions caused by the melting of great blocks of stagnant ice left behind by the retreating glacier and covered over with debris. "The Hogsback" (T. 30 N., R. 4 W., Sec. 3) is a gravel ridge that may be a short esker (deposits from a rapidly flowing stream beneath the ice). The materials of these areas range from silts through coarse gravels and probably are representative of most of the glacial outwash.

As the ice retreated and outwash materials were being deposited, the Dungeness and its neighboring streams flowed toward the ice to meet the sea wherever they could find exits. Climates, during the time of glacial recession, are thought to have been more severe than the present climate; and the Dungeness probably had a considerably greater discharge. The strong streams descending upon the loosely consolidated outwash were able to carve out a surface graded from the mountain front to a base level that was probably the ice front at first and later was sea level. Much of the surficial material was deposited directly by the northward flowing streams, and the resulting planar surface may be described as a combination of an alluvial plain and a pediment.

The older graded surfaces are designated "Qtal" on the geologic map. They were graded to a base level considerably higher than at present and probably were produced during the final retreat of the glacier. They were possibly graded to the ice front itself. In general, these areas have very thick deposits of silt on the surface and require deeper wells to penetrate water-bearing sands and gravels. Happy Valley is the most interesting of the older terraces. It is filled with a very thick sequence of alluvium; the upper part, at least, is silt and fine sand. It was occupied by a then more powerful Bell Creek and may once have been continuous with the terrace noted on Gierin Hill and possibly ended against the glacier. Retreat of the glacier, a relative lowering of sea level, and a decrease in discharge of Bell Creek allowed the Dungeness and its eastern neighbors to truncate the higher valley leaving it as a hanging valley. Bell Creek today is considerably weaker than it was even after the Dungeness truncated Happy Valley. It is now only a marshy drainage that would not have been responsible for cutting its present valley floor near its mouth.

The areas designated "Qal" are done so somewhat arbitrarily. They are thought to have formed after the final retreat of the ice and are related in that they were all graded to a lower sea level rather than the ice front or the pre-existing higher sea level. Furthermore, they comprise the great majority of the arable and irrigable land. In reality, the area is a series of surfaces that probably range in age from the youngest "Qtal" surface to the present day flood plain alluvium of the Dungeness. When the "Qal" surface first began forming, it may have been much more planar than it is now. The oldest preserved parts are adjacent to McDonald and Siebert Creeks. Well logs near McDonald Creek show a quite thick mantle of fine alluvium overlying gravels. This mantle was probably deposited during a period of aggradation by the streams. Since the time of aggradation (which was probably brief) a relative lowering of sea level has caused a more or less continuous period of downcutting by all the streams. Siebert and McDonald Creeks have cut deep canyons into their old surfaces while the Dungeness and eastern streams have managed to swing back and forth over their drainage areas leaving small terraces behind them as they cut down. Consequently, the land near the Dungeness generally has a much thinner mantle of fine material overlying the potential water-bearing sands and gravels.

Probably the latest geologic event is the continuing building of the numerous sand spits by longshore current action.

GROUND WATER

Occurrence.

Virtually all of the ground water within the report boundaries is derived from sands and gravels deposited by the northward flowing streams or as glacial outwash. This material is generally permeable enough to allow moderate flow rates of the ground water.

The water level of wells sunk directly into the permeable sands and gravels reflects the height of the water table or zone of saturation. The water table contours of plate 1 are developed mainly from well measurements of this sort; the contours give a rough representation of the status of the regional water table. Depth to water can theoretically be computed by taking the difference between the land surface altitude and water table altitude for any particular point. In a plain composed of uniformly permeable material, the ground-water table will ideally be parallel to the topography. Where this condition applies within the report area, the water table averages about 8 to 15 feet below the surface and will fluctuate seasonally. Irregular topography, varying depths of surface silts, and irregularly located deposits of clay and "hardpan" serve to complicate any simplified picture of the water table.

The thick surficial silts such as those in cross section A-A' (pl. 3) have a low enough permeability as to be almost non-productive. If the water table (saturated zone) is 20 feet below land surface yet the silts are 35 feet deep and underlain by water-bearing gravels, wells must penetrate the gravels to receive a sufficient supply of water. If left unpumped, the water will rise in the casing to meet the 20 foot water table. Upon pumping, the water level will draw down to a point where the recharge from the gravels balances the discharge of the pumps.

The above conditions determine an "unconfined" water table. The subsurface clays and "hardpan" cause a different type of complication. They are impermeable materials which may serve to confine under pressure the ground water contained in more permeable strata beneath them. If no saturated zone occurs in permeable material above the clay, well drills will not encounter productive quantities of water until they have passed through the impermeable stratum. The water then encountered rises in the casing to a height corresponding to the pressure head on the confined ground water (Sceva, 1957, p. 31). Several wells throughout the report area encounter impermeable strata at various levels. For a permanent water supply it is usually necessary to drill through them if they are encountered close to the regional water table. In a few cases, shallow wells penetrating "hardpan" produce artesian wells which flow or come very near the land surface. Two very deep wells near the east coastline (30/3W-5B1 and 15G1) penetrate confining strata allowing strongly flowing artesian production. Usually, however, the impermeable strata serve as an unfortunate obstruction to good wells rather than an aid.

Ground Water Movement.

The flow of ground water at any point is perpendicular to the water table level which is represented by the water table contours. Within the report area the flow probably assumes a fan-shaped pattern with the apex at the Dungeness River where it emerges from the mountains. This pattern is probably closely similar to the surface drainage pattern.

Recharge and Discharge.

Natural precipitation is the chief source of ground-water recharge in the average ground-water region. The Sequim-Dungeness area, however, is somewhat unusual in that annual precipitation is low and the ground-water supply is quite abundant. The major source of recharge is probably from precipitation, but most of that precipitation probably falls upon the mountains rather than on the plain. Some observers believe the Dungeness River itself decreases in volume as it flows toward the sea but no accurate stream gage measurements are available to confirm this; if this decreasing flow is true, the Dungeness would act as an important source of recharge. Happy Valley may indicate evidence for recharge from higher altitudes. This valley drains a sizeable watershed, but no surface stream remains in it--drainage must be nearly all sub-surface and eventually must infiltrate the water table in the Sequim vicinity.

An important secondary source of recharge is directly from irrigation. While natural precipitation is nearly absent during the summer months, much of the irrigated land receives a large quantity of water from both sprinkler and flood irrigation. (From a soil conservation standpoint, some of the land receives far too much irrigation water.) Evaporation and transpiration are high during the summer and much additional water is retained by the soil. There is an appreciable excess of water that is available to percolate directly to the water table. This water not only maintains the water table but builds it considerably higher. There are no annual hydrographs of wells (graphs of water levels plotted against time) in this area. Hydrographs from Thurston County of wells in similar geologic conditions and relative (although greater) precipitation show a water level peak in mid-winter with a steady decline until November at which time the levels rapidly rise toward the peak again (Wallace and Molenaar, 1960). Reports from well owners in the Sequim-Dungeness area indicate the water level peaks in late summer and is lowest in the winter; a few wells go dry in the winter. This phenomenon could only be caused by a six-month lag between precipitation and water level reflection or be due to a rapid recharge directly from irrigation supplies. The former reason is very unlikely in an area of highly permeable sand and gravel. Since most of the irrigation water is distributed by open, unlined ditches, much of the recharge must be delivered directly from ditch losses as well as from the irrigated soils. The following table shows examples of a mid-summer increase of the water table. Observations were made on a few representative wells in which static water levels could be reliably measured. The U. S. Geological Survey is tentatively planning to use these or similar wells to make monthly measurements to produce annual hydrographs.

TABLE 1. Wells used for recording static water levels during summer of 1960. Feet below land surface.

Well Number	June 15	July 18	August 9	Maximum noted increase in Water Level
30/3W-7R1	17.92	16.21	14.79	3.13
30/3W-16B2	26.04	23.53		2.51
30/4W-4P1	32.92	32.39		0.53
30/4W-15M2	12.57	11.35		1.22
30/4W-22J1		94.10	93.78	0.32

Ground-water discharge is accomplished by flow onto the surface (wells or springs) or directly into surface streams or the sea, and by evaporation, transpiration, and pumping from wells (Sceva, 1957, p. 33). All of these types of discharge occur within the report area, but the greatest discharge is probably directly into the sea and below sea level. A few springs occur locally near the base of the sea cliff. During the times of maximum water table there is probably some discharge into the Dungeness, but the balance between recharge by and discharge to the river is unknown. Present well use apparently has little effect on discharge patterns. Some wells located in poorly producing areas will pump dry, while wells developed in good aquifers can pump large quantities of water indefinitely without recognizable effects on the water table.

Areas Where Additional Ground Water is Available.

The most productive ground-water area occupies the region designated "Qal" on the geologic map from a general north-south line between McDonald Creek and the Dungeness River eastward to the coastline. It is this area which typically has a thin soil and silt mantle overlying thick deposits of sands and gravels. Many wells here are excellent producers capable of sustaining considerable irrigation. Two good, but not unusual, examples are wells 30/3W-7R1 (Sequim cemetery) and 30/3W-20C1 (just northeast of Sequim). The former irrigates the cemetery and has immediate recovery. The latter, a dug well, is capable of continuous production of 300 gallons per minute irrigating 40 acres of land. Wells in this area are generally between 20 and 40 feet deep. In some cases production may be increased by larger diameter or properly constructed deeper wells permitting a greater area of infiltration.

There are several poorly drained sub-areas within this area. Some locations noted are in the SE¼ of Section 20 east of Sequim; the SW¼ of Section 17 north of Sequim; and the area south of the Spath Road west of Carlsborg. Described as "sub-irrigated," it is thought that this condition represents a perched water table developed above an impermeable layer. Those areas with permeable materials near the surface could conceivably accommodate shallow, large diameter wells which would serve the dual purpose of supplying additional water during the irrigation season as well as helping to drain the adjacent land.

The low country near the coast both north and south of Gray's Marsh apparently has a good potential water supply, but very little well information is available. Driven sand points are common here but allow no water level measurements or knowledge of the materials penetrated. Near Dungeness there is some evidence of a shallow "hardpan" layer below which a good supply of water will rise close to the surface. In general, there seems to be a high water table, but the surficial material is often of low permeability. Maximum development of wells here may require drilling into more permeable material or else to enlarge the well diameter. Infiltration trenches are also a possibility.

Happy Valley is possibly a potential supply area, but more information is required here. Only deep wells seem to be suitable for permanent supplies. The fact that Happy Valley drainage is primarily sub-surface suggests that there is a very good supply of ground water available. The oil test well 30/3W-30Q1 (Dalton-Pettet #1) encountered flowing artesian water at both 256 and 800 feet, but quantities were not given. Although initially expensive, such wells might provide a valuable water supply. Near the head of the valley the Tertiary rocks are nearest the surface and might act as a water-bearing zone where they are in contact with the Pleistocene deposits. Basalt and fine sandstone crop out in road cuts above the west fork of Johnson Creek.

Areas Deficient in Ground Water.

The only areas truly deficient seem to be near the periphery of the Tertiary rocks. At these places the unstratified glacial drift is most common, and it directly overlies the nearly barren Tertiary rocks. There were no places noted where water was unavailable, but supplies are usually smaller or inadequate near the Tertiary rocks.

Wells located on the "Qtal" surfaces and the "Qal" in the western part of the report area are usually able to produce adequate supplies, but they must penetrate much deeper deposits of silt. Also, simply because of their higher elevation than the surrounding land, the "Qtal" areas have water tables farther below the surface. The area between McDonald and Siebert Creeks also has deeper wells due to a lower water table. Since excessive surface silts do not occur here, the reason for the depth of the water table is not understood.

The glacial gravels that have remained unworked by later streams (the northern areas of "Qg") seem to show poor potential, but very little well information is available here. Here again, the higher elevations plus the turbulently bedded character of the outwash do not seem to be conducive to economical production for purposes other than domestic supply.

Chemical Quality.

Table 2 shows partial chemical analyses made on randomly chosen wells in the area. The results show a general tendency toward hard and alkaline waters, but do not lend themselves to show close chemical similarity either vertically or laterally. Probably the areas of chemical similarity change as rapidly as does the geology.

Hardness is expressed as the equivalent hardness of otherwise pure water containing the stated amount of calcium carbonate in parts per million. Alkalinity is expressed in the same manner. The results of both tests may be converted to equivalent parts per million by dividing by 50. Alkalinity as calcium carbonate may be converted to bicarbonate by dividing the given result by 0.8202.

Hardness is a non specific term that generally represents the soap-consuming property of water or the incrustations left by water after it has been heated. Calcium and magnesium are chiefly responsible for these properties; hence, calcium carbonate is traditionally used as a criterion for hardness (Hem, 1959, p. 32-34). The U. S. Geological Survey defines hardness as calcium carbonate in parts per million as follows:

0- 60	Soft
61-120	Slightly hard
121-200	Hard
Above 200	Very hard

Chloride occurs in nearly negligible quantities in the waters sampled. The U. S. Public Health Service has set 250 parts per million as the upper limit for chloride in acceptable water. Rain water has an average of three parts per million, and sea water has 18,980 parts per million (Hem, 1959, p. 103-111). Chloride content shows a marked increase when sea water encroaches on ground-water reservoirs--there is no suggestion of this within the area of this report.

The chemical analyses were made by the writer with the assistance and facilities of the Washington State Pollution Control Commission in Olympia.

CONCLUSION

The Sequim-Dungeness area has a potential water supply that will allow liberal and inexpensive irrigation wherever required and yet not deplete the natural water resources. The majority of the present irrigation supply is diverted from the Dungeness River, but the State Fisheries Department has requested that no additional water be diverted so the river can be preserved as a spawning area. Under present conditions, additional irrigation supplies are desirable as there is

TABLE 2. Partial chemical analyses of randomly sampled well waters in the Sequim-Dungeness area.

Well number	Hardness (as $CaCO_3$) ppm	Alkalinity (as $CaCO_3$) ppm	Chloride ppm	SO_4*	Well depth in feet
30/3W-6C1	169	106	23	neg	7
30/3W-7R1	133	122	4	neg	35
30/3W-17F1	118	112	2	neg	32
30/4W-7K1	93	92	6	neg	96
30/4W-8G1	166	174	8	neg	100
30/4W-17G1	45	94	3	neg	97
30/4W-18A1	111	104	6	neg	145
30/4W-20C1	144	150	8	neg	108
30/4W-23J1	85	76	2	neg	20
30/5W-12L1	89	90	5	neg	99
30/5W-13E1	75	58	5	neg	20
30/5W-13K1	129	130	6	neg	5
31/4W-26M1	160	158	12	neg	49

*"neg" means less than 50 ppm

much land near the extremes of the ditches not receiving a full supply of water; yet these lands are fully assessed for water. Additional supplies may be obtained in two ways: (1) A more efficient distribution system that allows less water loss during transit and (2) supplementing the existing supply by the use of large quantities of ground water which could be pumped into existing ditches or used to irrigate directly from the wells.

A closed pipe distribution system was proposed and outlined by the Bureau of Reclamation. This system would be initially expensive but would have the long range advantage of reducing individual pumping costs by providing sprinkler head pressures as well as greatly reducing evaporation and seepage losses in transit. It would also partially combine and simplify the presently complicated system of irrigation districts and ditch companies that have grown sporadically since irrigation began in the area over 60 years ago. If additional water is still required beyond the allowable stream diversion limits, it could be obtained from properly located wells.

Directly supplementing the existing ditch supplies by the use of ground water would be initially less expensive than a closed pipe system but less efficient over the years if the present ditch system is retained. Well-water supplements could be made by either the irrigation districts or ditch companies, or on an individual basis by the farmer who needs more water. Present well drilling costs range from $7.50 per foot for 6-inch casings to $15.00 per foot for 12-inch casings, and there are many good producing wells no deeper than 25 feet that are capable of irrigating at least 50 acres. Well drilling involves uncertainties, but a study of the well location maps (pl. 1) and the records of nearby wells (table 3) can greatly improve the probability for success. For example, the Agnew district has a water table 70 or 80 feet below land surface and water quantities are uncertain. In contrast the Carlsborg area generally has a shallow water table with excellent production. The irrigation districts and ditch companies are in a better position to experiment in determining correct locations and construction of large producing wells than individual farmers. Also, they can transport water from good ground-water areas to the areas where neither present ditch supplies nor potential ground-water supplies are available. In locating new well sites, water-logged lands with wells of large infiltration area should be seriously considered. In any event, the potential well owner is advised to consult a reliable ground-water geologist or well driller who is familiar with the district.

EXPLANATION OF PLATES AND TABLES

Much of the data collected for this report is incorporated in the following tables. These data were collected in the field during the summer of 1960 or combined from several miscellaneous sources of earlier work already cited.

Table 3, records of wells, lists the pertinent information of all the water wells recorded in the area. Abbreviations used are explained in the table. Depths used are in feet below land surface; depths given in whole numbers are reported and cannot be assumed to be absolutely correct while those depths followed by one or two decimal numbers have been accurately measured in the field. In many cases, wells are sealed such that measured depths could not be obtained. Altitudes of wells are interpolated from the U. S. Geological Survey topographic maps.

Table 4 is a compilation of well logs. The information was derived from owner's reports, driller's reports, and from water right applications made to the Division of Water Resources. Table 4 lists not only water wells (noted simply "well") but also seismic shot holes and oil test wells. The oil test well information was obtained from Oil and Gas Exploration in Washington (Livingston, 1958).

The terminology used in the well logs is that of the driller or the source record unless enclosed in parentheses. Parenthetical terms are interpretations or paraphrases of the original terms and are made by the writer. Driller's terms are often confusing, when used in a geologic sense, but are usually appropriate for a general description of the materials penetrated.

Plates 1 and 2 are developed from the original U. S. Geological Survey topographic sheets. Water well locations in plate 1 were obtained by pacing from the nearest landmark and scaling directly onto the map. Location accuracy is well within the area covered by the map symbol. Shot hole locations were transferred from the Standard Oil Company shot hole location map, and their accuracy can be assumed to be only approximate. Oil well locations were obtained from legal descriptions of the wells. Plate 3 shows representative cross sections along the lines marked on the geologic map (pl. 2). The cross sections are highly generalized--they intend to show basic geologic differences interpreted from well logs and are not to be assumed accurate enough to use as a drilling guide.

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Table 3. -- Records of Wells.

Explanation:
Well No: Locations are shown on plate 1. Numbering system explained on page 3.
Altitude: Interpolated from U. S. Geological Survey topographic maps.
Type of well: Dg, dug; Dn, driven; Dr, drilled.
Depth of well: Depths reported by owners are in whole numbers. Depths measured during field examination given to tenths of a foot.
Water level depth below land surface: Depths given to hundredths were measured during field examination on the date noted.
Pump: C, centrifugal; J, jet; N, none; P, piston; S, submersible; T, turbine.
Use: D, domestic; Dairy, barn and milkhouse use; Irr, irrigation; N, not used; P.S., public supply; S, stock.
Remarks: DD, drawdown; gpm, gallons per minute; L, well log in table 4; Perf, perforations; S, partial chemical analysis in table 2; SWL, static water level; ppm, parts per million.

Well No.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Character of water-bearing material	Water level		Pump		Use of water	Remarks
								Below land surface (feet)	Date	Type	Horsepower		
T. 29 N., R. 3 W.													
2C1	Sequim State Park	170	Dr	492	8	111	gravel w/shale	--------	-----------	---	----	N	(L) Perf. at 78-84 and 108-111 ft.
4D1	Buyers, Otto H.	675	Dr	121	6	121	med. sand	112	8-9-60	N		D	(L) Bailed 8 gpm with 3½ ft DD.
T. 30 N., R. 3 W.													
5 B1	U.S. Government	5	Dr	265	6	-------	sand	Flows	7-27-50	N		P.S.	Flows 64 gpm, steady. Hardness 112.
5H1	Dr. Wilcox	8	Dr	30.15	6	-------	gravel	5.95	6-17-60	N		D	DD 5 ft after pumping 2 hrs at 18 gpm.
6C1	Evans, Frank	30	Dg	7.3	36	-------	gravel	3.44	7-21-60	C	1	D	(S) Good yield.
6N1	Kirner, Conrad	105	Dr	84	9	84	gravel	63.69	8-8-60	J	1	D	Will pump dry; rapid recovery. River silt 80 ft, gravel 4 ft.

Table 3. -- Records of wells, -- Continued

Well No.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Character of water-bearing material	Water level: Below land surface (feet)	Water level: Date	Pump: Type	Pump: Horsepower	Use of water	Remarks
							T. 30 N., R. 3 W. -- Continued						
6R1	Anginli, Nick	60	Dg	22	6	-------	gravel	18	1950	J	---	D	(L) Supply inadequate.
7A1	Still, Chas.	60	Dr	32.0	6	-------	-------------	19.19	8-8-60	J	3/4	D	-----------------------------
7D1	Gaskell, Robt.	102	Dr	130	6	130	sand & gravel	75	Oct, 58	J	1	D, Dairy	(L) DD 10 ft pumping 20 gpm.
7L1	Griffith, John T.	100	Dr	46	8	-------	sand & gravel	26.69	8-8-60	J	1	D	(L) DD 2 ft after 2 hrs pumping 200 gpm.
7R1	Sequim cemetery	118	Dr	35	6	-------	sand & gravel	14.79	8-8-60	J	1	Irr	(S) Water level has immediate recovery.
8C1	Cassalery, Moe	35	Dn	30	-----	-------	-------------	13	----------	C	1	D,S	Good supply.
8R1	Stares, Geo.	116	Dg, Dr	84	-----	-------	fine sand	76	----------	J	1½	D,S	Pumps 5 gpm.
9K1	Grays Marsh Farms	100	Dr	40	6	-------	-------------	39+	----------	T	----	D, Dairy	-----------------------------
15G1	Coulter & Scott	20	Dr	574	8	574	fine gravel	Flows	4-13-51	T	5	D, Irr	(L) Perf, see log; flows in excess of 100 gpm.
16B1	Snider, Grant E.	108	Dr	39	6	-------	gravel	19	----------	C	3/4	D	-----------------------------
16B2	Grays Marsh Farms	102	Dg	27.8	36	-------	-------------	23.53	7-19-60	J	1/2	N	Polluted.
16E1	Willis	132	Dr	60	-----	-------	sand	45	----------	J	1/2	D	Pumps 6 gpm.
17F1	Stone, Stacey	108	Dr	32	6	-------	-------------	7	----------	C	1	D,S	(S) Pumps 17 gpm steadily.
20A1	Blake, Ed	110	Dr	34.0	6	-------	sand	11.56	8-8-60	C	3/4	D, Dairy	(L) Pumps 10 gpm.

20B1	Bucher, John	140	Dr	23.2	6	-------	-------------	0.0	7-27-50	C	1/4	Irr, Dairy	Hardness 146.
20C1	Clayton, T. J.	145	Dg	50	42	-------	-------------	9	4-20-49	C	7½	D,S, Irr	(L) Irr 40 acres. DD 10½ ft after 4 hrs pumping 300 gpm.
21K1	Fishel	117	Dr	117	6	116	sand & gravel	99	----------	J	1½	D	(L) Perf. 103-116 ft; no DD after 4 hrs pumping 17 gpm.
22N1	Eberly, Geo.	205	Dr	179	6	179	gravel	150	1959	S	1/2	D	(L) DD 15 ft after 2 hrs pumping 5 gpm.
27B1	Whitfield	50	Dr	66	6	64	sand & gravel	35	May, 55	J	1/2	D	(L) DD 12 ft after pumping 9 gpm.
27B2	Forest, Eugene	40	Dr	64.0	8	-------	-------------	25.30	8-8-60	J	1	D	Poor supply. Hard, iron stain.
27B3	Evans, Fred G.	25	Dr	8.0	5	16	sand	2.99	8-8-60	C	1/2	D	Poor supply. Iron stain.
27C1	McCorie, Wm.	150	Dr	35	6	-------	-------------	-------	----------	J	1	D,S	------------------------------
28H1	Tripp, O.B.	220	Dr	400	4	-------	sand & shale	190	Aut. 1948	P	1½	D, Dairy	Hardness 18 ppm. Good producer.
31J1	Dubuque, Peter	580	Dg	12.4	-----	-------	-------------	8.63	8-9-60	C	3/4	D	Poor supply, slow recharge.

T. 30 N., R. 4 W.

1K1	Lewis, Chas. D.	128	Dr	143	6	-------	gravel	99	----------	S	3	----	(L) DD 10 ft after pumping 40 gpm, rapid recovery.
2M1	Schmuck, Hans	70	Dr	50.7	7	-------	-------------	8.64	8-10-60	P	---	D, Dairy	------------------------------
2P1	Mantle, Rex J.	82	Dg	9.5	28x28	-------	gravel	5.16	8-9-60	C	1	D, Dairy	(L) DD 4 ft after pumping 50 gpm, fast recovery.
3H1	Schreiner, James	72	Dg	------	40	-------	-------------	3.20	8-9-60	C	1	D	Good supply.
4P1	Cameron, Howard	125	Dr	48	6	-------	-------------	32.39	7-18-60	J	1	S	------------------------------
5N1	Lewis, D.H.W.	128	Dr	95.4	6	-------	-------------	81	Jan, 60	J	1	D,S	------------------------------
7F1	Niemi, Roy I.	148	Dr	70.7	6	-------	-------------	64.25	7-19-60	J	---	D	------------------------------
7K1	Grimsley, D. K.	170	Dr	96	6	-------	-------------	--------	----------	J	1/2	D	(S)
8G1	Burdick, W. H.	140	Dr	104	6	98	sand & gravel	59	May, 1960	J	3/4	D	(L) (S)
8J1	May, Bud	158	Dr	56	6	45	sand & gravel	38	Feb, 1960	J	1	D	(L) DD 13 ft after pumping 17 gpm.
9C1	Cameron, Howard	125	Dr	70	6	------	coarse sand	--------	----------	J	3	D, Dairy	No DD after 5 hrs pumping 25 gpm.
9K1	Cameron, V. W.	140	Dr	21.8	6	-------	-------------	9.63	7-22-60	P	---	D,S	------------------------------
10L1	Cook, Norman	122	Dr	22	6	-------	gravel	2	----------	C	1/4	D	------------------------------
10P1	Wilder, Paul	118	Dg	10	13	-------	sand	5	----------	C	1/2	D, Irr	------------------------------
11L1	Carey, J. J.	118	Dr	16	6	-------	-------------	12	----------	C	1/2	D	------------------------------

Table 3. -- Records of wells. -- Continued

Well No.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Character of water-bearing material	Water level: Below land surface (feet)	Water level: Date	Pump: Type	Pump: Horsepower	Use of water	Remarks
T. 30 N., R. 4 W. -- Continued													
12M1	Krizo, Frank	115	Dg	13	18	-------	gravel	8	-----------	C	5	Irr	(L) Irr 19 acres. No DD after 10 hrs pumping 120 gpm.
12Q1	Robins, Lester	119	Dr	25.0	6	20	sand & gravel	5.33	8-9-60	N		----	(L) DD 4 inches after 1 hr pumping 65 gpm. Perf.
12Q2	Robins, Lester	118	Dr	25	10	25	-------------	--------	-----------	C	5	Irr	Irr 22 acres. Perf 11-25 ft. DD 2 ft after 24 hrs pumping 160 gpm.
13D1	Fasola, Alfred	132	Dr	24	4	-------	gravel	8	-----------	C	1/4	D	-----------------------------
13H1	Robinson, C. A.	157	Dr	30	6	-------	gravel	25	-----------	J	3/4	D,S	-----------------------------
13Q1	Priest, R.	170	Dr	36	6	-------	-------------	--------	-----------	J	1/2	D	Hardness, 122.
14C1	Heath, Olive	140	Dr	20.7	6	-------	-------------	12.01	8-9-60	C	1/2	D	-----------------------------
14F1	Adams, Elmer E.	155	Dg	30	30	-------	gravel	12	-----------	C	3	Irr	(L) DD 1 ft after 10 hrs pumping 100 gpm. 5 min recovery.
15G1	Avery, Robt.	155	Dr	50	6	-------	-------------	6	-----------	P	hand	D	-----------------------------
15H2	Avery, Robt.	158	Dr	50	6	-------	-------------	6	-----------	C	3	D,Irr	No DD pumping 25 gpm.
15H3	Avery, Robt.	155	Dr	50	6	-------	-------------	6	-----------	C	hand	D	-----------------------------
15M1	Gillespie, F.	155	Dr	14.5	6	-------	-------------	5.20	6-16-60	N		N	Iron stain.
15M2	Gillespie, F.	155	Dr	42.5	6	-------	gravel	11.35	7-19-60	C	1/4	D	-----------------------------
16K1	Frantz, John	195	Dr	63.1	6	-------	-------------	60.56	7-22-60	J	1½	D,S	-----------------------------
17D1	Simonson, Henry	200	Dg, Dr	146	5	-------	very coarse sand	65	1947	P	1	D,S	(L) Very good supply.
17G1	Miller, W. S.	200	Dr	97	6	-------	-------------	65.40	7-22-60	J	1	D	(S) Est. yield: 33 gpm.
18A1	Kovoch, Nick	210	Dr	145	6	-------	-------------	86.82	7-19-60	J	1	D,S	(S)

19J1	Sampair, J. A.	420	Dg	9.9	12	9.5	gravel & boulders	5.77	8-9-60	P	1/2	D	Pumps dry in spring.
20C1	Fox, H. C.	375	Dr	108	8	-------	gravel	76	1947	J	1½	D	(S) (L) Est. yield: 5 gpm. Has pumped dry.
21B1	Spencer, Chas.	238	Dr	38	6	-------	--------------	Flows	6-16-60	C	1/2	D	Will pump dry.
22J1	Lochow, F. A.	238	Dr	109	6	-------	--------------	93.78	8-9-60	J	3/4	D	-----------------------------
22J2	Stoican Drilling Company	238	Dr	150	6	-------	sandy gravel	81.64	7-21-60	J	1½	D	(L)
23E1	Burton, C. H.	238	Dg	16	72	-------	coarse gravel	7	-----------	C	7½	Irr	(L) DD 6 to 8 ft after 6 hrs pumping 175 gpm.
23J1	McKeague, D. H.	240	Dr	20	6	-------	--------------	13.32	7-21-60	C	1/2	D	(S) Good supply.
23L1	Wallis, A. T.	245	Dg	20	24	20	sand & gravel	7	Summer, 51	C	1/2	D	(L) No DD after pumping 7 gpm.
24B1	Sanford	200	Dr	45	6	-------	gravel	30	-----------	J	3/4	D, S	-----------------------------
25E1	Jones, R. O.	321	Dr	48	6	-------	gravel	32	-----------	J	1/2	D	-----------------------------
25G1	Livingston, W. W.	323	Dg, Dr	72	6	-------	fine sand	30	-----------	J	1	D	-----------------------------
26C1	Roberts, C. B.	278	Dg	15	36	-------	gravel	8	-----------	C	1/2	D	-----------------------------
26R1	King, C. W.	358	Dr	57	6	57	gravel	12	4-3-46	J	3	D, S, Irr	(L) DD 37 ft after 4 hrs pumping 37 gpm.
27A1	Bentz, K. A.	320	Dr	74	6	74	gravel	65.20	8-9-60	J	1/2	D	(L) DD 2 ft after pumping 10 gpm. Rapid recovery.
27G1	Callis, John L.	475	Dr	67.9	8	64	"sandstone"	56.50	8-9-60	J	1/2	D	DD 1½ ft after 1 hr pumping 5 gpm.
							T. 30 N., R. 5 W.						
12D1	Galloway, Elmer	180	Dr	110	5	110	sand & gravel	79.75	7-20-60	J	3/4	D, S	Adequate supply.
12H1	Jarvis, E. J.	145	Dr	76	6	-------	--------------	67.48	7-22-60	J	1	D, S	Rapid recovery.
12L1	Dickinson, G.	190	Dr	102	6	-------	--------------	97.19	7-22-60	J	1	D	Serves 2 houses.
12N1	Adolphsen, P.	115	Dg	4.0	36	4	sand	0.81	7-20-60	J	1/2	D, S	Probably spring fed.
13E1	Bailey, W. D.	246	Dr	20.1	8	-------	sand	1.55	7-20-60	C	1/3	D, S	(S) Penetrates clay stratum. Has flowed.
13K1	Crain, Ray	308	Dg	4.5	24	-------	sand	2.0	7-20-60	C	1/3	D, S	(S) Penetrates "hardpan."

Table 3. -- Records of wells. -- Continued

Well No.	Owner or tenant	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Character of water-bearing material	Water level		Pump		Use of water	Remarks
								Below land surface (feet)	Date	Type	Horsepower		
							T. 31 N., R. 3 W.						
18F1	Dungeness Lighthouse, U. S. Department of Commerce	5	Dr	667	------	-------	sand & gravel	Flows	9-14-30	--	----	-----	(L) Flowed 80 gpm. Later pumped 50 gpm. Not located on map.
30M1	Marshall, Ernest	8	Dr	48	6	-------	gravel	4.60	7-22-60	C	1/2	P.S.	Pumps 27 gpm with small DD. Sand 45 ft; hardpan 3 ft; gravel bottom (restaurant).
							T. 31 N., R. 4 W.						
25P1	Franzen, H. L.	60	Dr	74	6	-------	gravel	--------	-----------	J	1	D	-----------------------------
26G1	San Juan Farms	5	Dr	98	6	-------	sand	Flows	6-16-60	P	1/3	D	Flows 2-3 gpm. Hardness 126.
26M1	Van Bibbler, N.O.	40	Dr	48.8	6	-------	--------------	42.67	7-21-60	J	1/2	P.S.	(S) Serves tourist cabins.
26Q1	Bigelow, E. C.	58	Dg	92	10	-------	sand & gravel	89	-----------	J	3/4	D	-----------------------------
27Q1	Olson, C. L.	60	Dr	84.1	6	-------	--------------	49.46	7-21-60	N		D	-----------------------------
34H1	Leach, L. W.	130	Dr	126	------	-------	--------------	--------	-----------	P	2	D	Iron staining; serve 2 families.
34P1	Kinnaman, Jim	90	Dr	90	6	-------	--------------	--------	-----------	J	1	D, Dairy	Iron stain.
35A1	Clark, E.	84	Dr	90	6	-------	gravel	--------	-----------	J	1	D,S	-----------------------------
35J1	Beebe, Chas.	28	Dr	65	------	-------	--------------	--------	-----------	J	3/4	D,S	Good supply. Well buried in pasture.
35L1	Harig, Richard	128	Dr	121.7	6	-------	--------------	10.95	8-9-60	--	----	D	-----------------------------
36L1	Mapes, James	23	Dn	25	2	-------	gravel	--------	-----------	C	1/4	D,S	Good supply.
36M1	Seamands, Mel	28	Dg	14.0	12	None	sand	3.60	8-9-60	C	1/2	D	-----------------------------

Table 4. -- Well Logs.

Well-numbering system explained on pages 3 and 4. Terms are as reported by owner or driller except those in parentheses which are the writer's.

Materials	Thickness (feet)	Depth (feet)

Well 29/3W-2C1

Sequim State Park. Altitude about 170 feet. Drilled by J. P. Davidson.

Topsoil and gravel ----------------------------------	20	20
Shale ---	58	78
Shale and gravel, water-bearing --------------------	1½	79½
Shale ---	30	108½
Shale and gravel, water-bearing --------------------	1	109½
Shale ---	249	358½
Shale with streak of black rock ----------------------	109	467½
Black rock (probably weathering phenomenon of the shale) (Contains Tertiary marine fossils)	25	492½

Perforated from 78 ft to 84 ft and 108 ft to 111 ft.

Well 29/3W-4D1

Otto H. Buyers. Altitude about 675 feet. Drilled by Stolcan, 1960.

Sandy brown clay ------------------------------------	9	9
Gravelly blue clay -----------------------------------	9	18
Medium boulders and clay ---------------------------	9	27
(Gravelly brown clay) --------------------------------	35	65
Sandy brown clay ------------------------------------	55	120
(Medium-grained sand with rare gravel) ---------------	1	121

Bailed 8 gpm with 3½ ft DD; SWL 112 ft.

Oil Test Well 30/3W-5D1

Dalton-McInnes No. 2. Altitude about 20 feet. Drilled by Dan Dalton, 1947.

Well penetrates glacial drift only --------------------	600	600

Well 30/3W-6R1

Nick Anginli. Altitude about 60 feet. Dug by owner.

Clay --	10	10
Hardpan --	8	18

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)
Well 30/3W-5D1 -- Continued		
Sand and gravel	4	22

Supply inadequate; SWL 18 ft.

Shot-hole 30/3W-7A2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 55 feet.

Clay (soil and river silt)	5	5
Gravel	15	20

Shot-hole 30/3W-7C1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 100 feet.

Clay (and silts?)	45	45
Sand and gravel	35	80

Well 30/3W-7D1

Bob Gaskell. Altitude about 102 feet. Drilled by Stoican, 1958.

Brown clay	33	33
Silty blue clay	19	52
Cemented blue clay with gravel	13	65
Hardpan	16	81
Sandy clay and gravel	18	99
Blue, sticky clay	25	124
Hardpan	2	126
Coarse sand and gravel	4	130

DD 10 ft after pumping 20 gpm; SWL 75 ft.

Shot-hole 30/3W-7D2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 108 feet.

Clay (and silts?)	58	58
Gravel	22	80

Materials	Thickness (feet)	Depth (feet)

Well 30/3W-7L1

J. T. Griffith. Altitude about 100 feet. Drilled by Stoican, 1960.

Brown, sticky clay	8	8
Medium- to fine-grained sand	11	19
Brown, sandy clay	13	32
Coarse sand to fine gravel	7	39
Coarse gravel with sand	7	46

DD 2 ft after 2 hrs pumping 200 gpm; SWL 26.69 ft.

Shot-hole 30/3W-8C2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 42 feet.

Clay (soil and silt)	8	8
Gravel	42	50

Shot-hole 30/3W-8J1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 116 feet.

Clay (soil and silt)	70	70
Gravel, water-bearing	20	90

Shot-hole 30/3W-8J2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 118 feet.

Clay (soil and silt)	20	20
Sand and gravel	65	85
Clay and gravel	35	120

Shot-hole 30/3W-8K1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 118 feet.

Clay (soil and silt)	20	20
Gravel	75	95
Sand and clay	25	120

Table 4. --Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)
Shot-hole 30/3W-8K2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 116 feet.		
Clay (soil and silt)	10	10
Gravel and boulders	80	90
Clay, sandy	10	100
Shot-hole 30/3W-9Q1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 102 feet.		
Clay (soil and silt)	32	32
Gravel and clay	38	70
Shot-hole 30/3W-15D1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 98 feet.		
Sand and gravel	70	70
Well 30/3W-15G1		
Coulter and Scott. Altitude about 20 feet. Drilled by N. C. Jannsen Company.		
Loose gravel	25	25
Gray clay	70	95
Blue clay	26	121
Gravel and boulders	57	178
Sand	17	195
Clay and gravel	105	300
Clay	60	360
Gravel and clay	10	370
Gravel and sand	15	385
Gravel and clay	21	406
Clay	59	465
Sand	10	475
Sandy clay	10	485
Clay	30	515
Small washed gravel	39	554

Materials	Thickness (feet)	Depth (feet)

Well 30/3W-15G1 -- Continued

Clay	20	574

Flows in excess of 100 gpm; perforations from 523 ft to 569 ft; SWL over 30 ft above land surface.

Oil Test Well 30/3W-17G1

Dungeness Unit No. 1. Altitude about 84 feet. Drilled by Standard Oil Co. of California, 1956.

Bottom of Pleistocene		2105
Bottom of Clallam conglomerate		3285
Bottom of Blakely Fm.		4550
Bottom of Lincoln Fm.		6363
Top of Eocene volcanics		6363
Depth of well		7493

Shot-hole 30/3W-19C1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 180 feet.

Gravel	65	65
Clay	5	70

Well 30/3W-20A1

Ed Blake. Altitude about 110 feet. Drilled by Van Ausdle, 1956.

Soil	12	12
Gravel	4	16
Hardpan	2	18
Fine sand	16	34

Pumps 10 gpm; SWL 11.56 ft.

Well 30/3W-20C1

T. J. Clayton. Altitude about 145 feet. Dug, 1949.

Gravel	8	8
Hardpan (questionable)	46	54

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)

Well 30/3W-20C1 -- Continued

Irrigates 40 acres; DD 10 ft after 4 hrs pumping 300 gpm; SWL 9 ft; well dimensions: 50 ft by 3½ ft.

Well 30/3W-21K1

Fishel. Altitude about 162 ft. Drilled by Stoican.

Cemented gravel and clay	36	36
Hardpan	29	65
Coarse sand and gravel	29	94
Cemented gravel	8	102
Coarse sand and gravel with hard clay layers	9	111
Blue, cemented gravel	4	115
Coarse sand and gravel	2	117

No DD after pumping 4 hrs at 17 gpm; perforated from 103 to 116 ft; SWL 99 ft.

Well 30/3W-22N1

George Eberly. Altitude about 205 feet. Drilled by Stoican.

Cemented gravel	24	24
Clay, sand, and gravel	36	60
Small gravel	27	87
Gray clay	12	99
Cemented gravel	49	148
Sandy clay	6	154
Cemented gravel	3	157
Gray clay and cemented gravel layers	22	179

DD 15 ft after pumping 2 hrs at 5 gpm; SWL 150 ft.

Well 30/3W-27B1

Whitfield. Altitude about 50 feet. Drilled by Van Ausdle.

Topsoil	2	2
Hardpan, clay and gravel	44	46
Sand and gravel	10	56
Gravel	10	66

DD 12 ft after pumping 9 gpm; SWL 32-38 ft with tidal action.

Material	Thickness (feet)	Depth (feet)

Oil Test Well 30/3W-30Q1

Dalton-Pettet No. 1. Altitude about 496 feet. Drilled by Dan Dalton, 1948.

Bottom of glacial drift (top of Tertiary)		1892
Finished in Blakely (?) Fm.		3619

One slight oil show. Artesian water flows at 256 and 800 ft.

Shot-hole 30/4W-1C1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 60 (?) feet.

Gravel and boulders	60	60

Shot-hole 30/4W-1F1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 55 feet.

Sand and clay	30	30
Gravel and boulders	70	100

Shot-hole 30/4W-1F2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 105 (?) feet.

Clay	29	29
Gravel	46	75
Sand, hard	15	90

Well 30/4W-1K1

Chas. D. Lewis. Altitude about 128 feet. Drilled, 1953.

Soil, sandy loam	5	5
Gravel	134	139
Gravel, cemented with clay	4	143

DD 10 ft after pumping 40 gpm, rapid recovery; SWL 99 ft.

Table 4. -- Well Logs. -- Continued

Material	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-1L1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 122 feet.

Gravel	80	80

Shot-hole 30/4W-1L2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 118 (?) feet.

Sand and clay	60	60
Boulders and gravel	40	100

Shot-hole 30/4W-2D1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 63 feet.

Clay (soil and silt)	5	5
Gravel	35	40

Shot-hole 30/4W-2E1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 64 feet.

Clay (soil and silt)	10	10
Gravel	55	65
Blue clay	15	80
Clay with sand streaks	40	120

Shot-hole 30/4W-2M2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 68 feet.

Gravel	55	55
Clay	15	70

Material	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-2M3

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 72 feet.

Clay (soil and silt)	7	7
Gravel	56	63
Clay	72	135

Shot-hole 30/4W-2N1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 78 feet.

Clay (soil and silt)	6	6
Gravel	46	52
Clay	68	120

Well 30/4W-2P1

R. J. Mantle. Altitude about 82 feet. Memory log of owner.

Soil	7	7
Clay	1	8
Very-fine gravel	1½	9½

DD 4 ft after pumping 50 gpm; rapid recovery; SWL 5.16 ft.

Well 30/4W-8G1

Wm. H. Burdick. Altitude about 140 feet. Drilled by Stoican, 1960.

Fine, brown sandy clay	7	7
Fine, brown sand and gravel	4	11
Gravel with clay	45	56
Blue, sticky clay	42	98
Coarse, dark sand and gravel	2	100
Cemented sand	4	104

SWL 59 ft.

Shot-hole 30/4W-8M1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-8M1 -- Continued

about 156 feet.

Clay (soil and silt)	18	18
Sand and gravel	32	50
Clay	20	70

Well 30/4W-8J1

Bud May. Altitude about 158 feet. Drilled by Stolcan, 1960.

Open hole	15	15
(Silt)	29	44
Sandy brown clay	9	53
Sand and gravel	3	56

DD 13 ft after pumping 17 gpm; SWL 38 ft.

Shot-hole 30/4W-9C2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 130 feet.

Clay, sandy (soil and silt)	40	40
Sand and gravel	30	70
Sand	30	100

Shot-hole 30/4W-9F1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 132 feet.

Clay (soil and silt)	15	15
Sand	53	68
Gravel	17	85
Sand and clay	20	105

Shot-hole 30/4W-9F2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 134 feet.

Clay, sandy (soil and silt)	40	40

Materials	Thickness (feet)	Depth (feet)
Shot-hole 30/4W-9F2 -- Continued		
Gravel and sand	20	60
Clay and sand	40	100
Shot-hole 30/4W-9L1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 137 feet.		
Clay (soil and silt)	10	10
Sand	23	33
Gravel	37	70
Shot-hole 30/4W-9P1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 142 feet.		
Clay and sand (soil and silt)	35	35
Sand and gravel	15	50
Shot-hole 30/4W-9P2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 142 feet.		
Clay (soil and silt)	30	30
Gravel	20	50
Shot-hole 30/4W-9R1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 130 feet.		
Sand	20	20
Gravel and boulders	30	50
Shot-hole 30/4W-10Q1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 117 feet.		
Clay (soil and silt)	8	8

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)
Shot-hole 30/4W-10Q1 -- Continued		
Gravel	34	42
Sand	8	50
Shot-hole 30/4W-11D1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 90 feet.		
Clay (soil and silt)	10	10
Gravel	50	60
Clay	58	118
Gravel	22	140
Shot-hole 30/4W-11D2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 92 feet.		
Clay (soil)	6	6
Gravel	49	55
Clay	95	150
Shot-hole 30/4W-11E1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 99 feet.		
Clay (soil)	6	6
Gravel	54	60
Sand with clay streaks	20	80
Blue clay	80	160
Shot-hole 30/4W-11L2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 110 feet.		
Clay (soil)	5	5
Gravel	45	50

Materials	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-11N1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 128 feet.

Materials	Thickness (feet)	Depth (feet)
Clay (soil and silt)	10	10
Gravel	40	50

Shot-hole 30/4W-11P1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 118 feet.

Materials	Thickness (feet)	Depth (feet)
Sand	4	4
Gravel and boulders	46	50

Shot-hole 30/4W-12C1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 123 feet.

Materials	Thickness (feet)	Depth (feet)
Sand and clay (soil and silts)	40	40
Boulders and gravel	60	100

Shot-hole 30/4W-12C2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 123 feet.

Materials	Thickness (feet)	Depth (feet)
Clay (soil and silts)	50	50
Clay and gravel	50	100

Well 30/4W-12M1

Frank Krizo. Altitude about 115 feet. Dug by Jack Ruona, 1957.

Materials	Thickness (feet)	Depth (feet)
Soil	2½	2½
Gravel	11	13½
Hardpan	?	13½

No DD after 10 hrs pumping 120 gpm; SWL 8 ft; irrigates 19 acres.

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)

Well 30/4W-12Q1

Lester Robins. Altitude about 119 feet. Drilled by Stoican.

Soil	1½	1½
Brown, sticky clay with some boulders	10½	12
Packed, brown sand and gravel	7	19
Sand and gravel, brown	4	23
Packed sand and gravel	2	25

DD 4 inches after 1 hr pumping 65 gpm: final 5 ft perforated; SWL 5.33 ft; Adjacent well irrigates 22 acres.

Shot-hole 30/4W-14D1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 135 feet.

Gravel	50	50

Shot-hole 30/4W-14D2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 147 feet.

Gravel	50	50

Shot-hole 30/4W-14E1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 153 feet.

Gravel and boulders	46	46

Shot-hole 30/4W-14E2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 158 feet.

Gravel and boulders	50	50

Materials	Thickness (feet)	Depth (feet)

Well 30/4W-14F1

Elmer E. Adams. Altitude about 155 feet. Dug well.

Clay loam	2	2
Soil and gravel	1	3
Clean gravel	27	30

DD 1 ft after 10 hrs pumping 100 gpm; recovers in 5 minutes; SWL 12 ft.

Shot-hole 30/4W-14K1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 175 feet.

Clay (soil)	5	5
Gravel and boulders	75	80

Shot-hole 30/4W-14M1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 170 feet.

Gravel	45	45
Sand	5	50

Shot-hole 30/4W-14Q1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 183 feet.

Gravel and boulders	40	40
Gravel	55	95
Clay	55	150

Shot-hole 30/4W-16C1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 145 feet.

Sand and clay	45	45
Gravel and sand	15	60
Clay	20	80

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-16F1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 138 feet.

Sand and clay with streaks of gravel	50	50

Shot-hole 30/4W-16F2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 156 feet.

Gravel	50	50

Shot-hole 30/4W-16L1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 192 feet.

Gravel	50	50

Well 30/4W-17D1

Henry Simonson. Altitude about 200 feet. Dug and drilled; memory log of owner.

Soil	18	18
Clay, sand, boulders--water-bearing	43	61
Blue clay	18	79
Quicksand	67	146
Very coarse sand and granule gravel (sample)	?	at bottom

Very good supply; SWL 65 ft.

Well 30/4W-20C1

H. C. Fox. Altitude about 375 feet. Drilled by Mykol, 1947. Memory log of owner.

Soil	5	5
Hardpan	30	35
Uncemented sand and gravel	65	100
(Quick) fine sand	3	103
Gravel	4	107

Materials	Thickness (feet)	Depth (feet)
Well 30/4W-20C1 -- Continued		
Clay-cemented sand and gravel	1	108

Yields 5 gpm; has pumped dry; SWL 76 ft.

Well 30/4W-22J2

Stoican Drilling Company. Altitude about 238 feet. Drilled by Stoican, 1959.

Materials	Thickness (feet)	Depth (feet)
Boulders and gravel	21	21
Brown, muddy sand--1½ gpm	2	23
Sticky, blue clay	42	65
Blue sandy clay	12	77
Brown sandy clay	35	112
Sandy brown gravel--1800 gpm	3	115
Cemented brown sand	35	150

Good supply; SWL 81.64 ft.

Shot-hole 30/4W-23B1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 218 feet.

Materials	Thickness (feet)	Depth (feet)
Gravel	40	40

Well 30/4W-23E1

Clarence N. Burton. Altitude about 238 feet. Dug, 1952.

Materials	Thickness (feet)	Depth (feet)
Clay (soil)	4	4
Sand	2	6
Gravel, no water	2	8
Coarse gravel	8	16

DD 6 to 8 ft after 6 hrs pumping 175 gpm; SWL 7 ft.

Shot-hole 30/4W-23G1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 240 feet.

Materials	Thickness (feet)	Depth (feet)
Clay (soil and silt)	65	65
Gravel and clay	15	80

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)

Shot-hole 30/4W-23K1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 245 feet.

Clay (soil)	5	5
Gravel and boulders	25	30
Gravel	20	50

Well 30/4W-23L1

Albert T. Wallis. Altitude about 245 feet. Dug by owner, 1951.

Heavy gravel	7	7
Semi-hardpan, gravel and clay	13	20
Hardpan	?	20

No DD after pumping 7 gpm; SWL 7 ft.

Shot-hole 30/4W-23P1

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 260 feet.

Gravel and boulders	20	20

Well 30/4W-26R1

Chester W. King. Altitude about 358 feet. Drilled by Mykol, 1946.

Clay loam	6	6
Gravel with some water	4	10
Hardpan	22	32
Gravel	1	33
Hardpan	18	51
Gravel and water	6	57

DD 37 ft after pumping 4 hrs at 37 gpm; SWL 12 ft.

Well 30/4W-27A1

K. A. Bentz. Altitude about 320 feet. Drilled by Stoican, 1959.

Materials	Thickness (feet)	Depth (feet)
Well 30/4W-27A1 -- Continued		
Soil	3	3
Gravel with small boulders	15	18
Cemented gravel	7	25
Fine gravel with some water	2	27
Hardpan	12	39
Sand and gravel	30	69
Coarse gravel	5	74

DD 2 ft after pumping 10 gpm; rapid recovery; SWL 65.20 ft.

Well 31/3W-18F1

Dungeness Lighthouse. Altitude about 5 feet. Drilled by Jannsen, 1930.

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Boulders	16	22
Coarse gravel	13	35
Boulders	7	42
Gravel	12	54
Fine gravel	4	58
Coarse gravel	8	66
Fine pea gravel	18	84
Gravel	38	123
Packed gravel	7	129
Gravel	9	138
Hard gravel	2	140
Hard-packed nigger heads	2	142
Gravel	8	150
Hard, fine gravel	5	155
Coarse gravel	2	157
Blue silt, sandy	12	169
Fine gravel	17	186
Coarse gravel	9	195
Gravel	4	199
Fine gravel	16	215
Gravel	6	221
Small gravel	11	232
Hard-packed gravel	24	256
Coarse gravel	10	266
Gravel	18'7"	284'7"
Sand and gravel, salt	8	292'7"
Sand and fine gravel	10	302'7"

Table 4. -- Well Logs. -- Continued

Materials	Thickness (feet)	Depth (feet)
Well 31/3W-18F1 -- Continued		
Black sand and salt water	4	306'7"
Fine black sand and salt	8'5"	315
Sand clay	9	324
Fine gravel mixed with clam shells	5	329
Blue clay	10	339
Blue clay compressed like rubber	20	359
Clay	6	365
Clay and boulders	18	383
Light blue clay	13	396
Clay and sand gravel	6	402
Loose clay and gravel	4	406
Boulders and clay	20	426
Clay hardpan	20	446
Blue gumbo	7	453
Gray clay and rock	31	484
Sand and gravel	15	499
Coarse sand	21	520
Sand and clay streaks	18	538
Gravel, sand and clay	16	554
Sandy clay streaks of cement gravel	48	602
Hard cement gravel	16	618
Sand, gray clay and gravel	27	645
Sandy clay	4	649
Cement gravel, very hard	18	667

Originally flowed at 80 gpm; well not located on location map.

Oil Test Well 31/3W-31Q1

Dalton-Pettet No. 2. Altitude about 16 feet. Drilled by Dan Dalton, 1950.

Poor oil showings; bottom of Pleistocene (top of Tertiary) about 2900 ft.

Shot-hole 31/4W-25P2

Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 18 feet.

Clay, (soil)	3	3
Gravel	27	30
Clay	10	40

Materials	Thickness (feet)	Depth (feet)
Shot-hole 31/4W-25Q1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 20 feet.		
Clay (soil)	5	5
Gravel	30	35
Clay	5	40
Shot-hole 31/4W-25Q2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 19 feet.		
Clay (soil)	5	5
Gravel	27	32
Clay	8	40
Shot-hole 31/4W-34Q1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 105 (?) feet.		
Clay (soil and silt)	15	15
Sand and gravel	70	85
Cemented sand and gravel	25	110
Shot-hole 31/4W-36P1		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 32 feet.		
Sand and clay	10	10
Gravel and boulders	40	50
Shot-hole 31/4W-36P2		
Drilled for Standard Oil Co. of California by Geophysical Surveys, Inc. Altitude about 40 feet.		
Sand	16	16
Gravel	34	50