PROGRESS REPORT ON THE GROUND-WATER RESOURCES OF THE HOUSTON DISTRICT, TEXAS

By

Walter N. White, Samuel F. Turner, and Penn Livingston

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Prepared in cooperation between the Texas Board of Water Engineers and the United States Geological Survey

March 1, 1937

Postscript, June 10, 1937

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Abstract

An investigation of the ground water, or underground water supply of Houston and the region surrounding it has been in progress for several years as part of a survey of the ground-water resources of Texas by the United States Geological Survey in cooperation with the State Board of Water Engineers. The investigation has covered Harris, Galveston and Waller Counties and a part of Montgomery, Fort Bend, Brazoria, Liberty and Grimes Counties. In the summer of 1933 the investigation was interrupted because of a reduction in the State appropriation, periodic observations of water level fluctuations in certain key wells, however, being continued--mostly by the Water Department of Houston. In the spring of 1936 the cooperative investigation was resumed following the appropriation of $1500 by the City of Houston and the matching of this amount with an approximately equal sum by the Geological Survey.

Results of the investigation were set forth in mimeographed memoranda which were released October 17, 1932, and December 29, 1933. In these reports the conclusion was reached that the available supply of ground water was adequate and it was pointed out that further material lowering in the artesian head which had already amounted to about 30 feet in parts of the Houston-Pasadena area, could be prevented and additional supplies could be obtained if in the future the city located its new wells at greater distances from the centers of the existing cones of depression, preferably toward the west and southwest. New industrial requirements for water in large quantities have recently developed in the vicinity of Pasadena, amounting, it is said, to a total of 20,000,000 to 40,000,000 gallons a day, representing from about 40 percent to about 80 percent of the total average daily supply pumped from all the wells of the Houston-Pasadena area up to this time. This proposed great increase in the use of water and the possibility that it may be followed by other large industrial demands has altered to a degree the aspects of the water supply situation.

The present report is based on data obtained from observations during 5 to 6 years. It comprises about 60 pages of manuscript and 138 pages of tables and is illustrated by hydrographs of water level fluctuations in wells and by a hydrologic map covering Houston and several thousand square miles of the adjacent region. (Copies of the report with all the tables are on file and available for public reference at the offices of U. S. Geological Survey at Washington, Texas Board of Water Engineers at Austin, and City Water Department at Houston.

About 1930 the total pumpage from all wells in the Houston-Pasadena area reached the maximum obtained up to that time, slightly under an average of 50,000,000 gallons a day. As the financial depression spread in 1931-32 the rate of pumping both from city and privately owned wells gradually declined and reached a minimum for the 1931-36 period in 1933, but the decline amounted to only 10 or 12 percent of the pumpage in 1930-31. Since 1933 there has been a gradual increase in the pumping and the total in the latter half of 1935 and the first half of 1936 was not greatly different from the total during corresponding periods in 1930-31.

For reasons explained in the report the artesian pressures in a group of observation wells in the spring are a more accurate index of prossures that exist generally in the underground reservoirs than those recorded at any other time. The trends in artesian pressure in the region between the spring of 1931 and the spring of 1936 (indicated by the records of water level fluctuations in wells) were as follows: In the Houston-Pasadena area there was a loss in head amounting on the average to less than 2 feet. North and northwest of Houston there are no deep wells that can be measured within several miles of the city limits, but farther out in the vicinities of Spring, Humble and Fairbanks apparently there was no material decline. West of Houston in the Katy rice-growming district there was a decline of $2\frac{1}{2}$ to 3 feet in several wells. Southwest of Houston at Bellaire the net decline amounted to about $2\frac{1}{2}$ feet. South and southeast of Houston in the localities of South Houston, Genoa, Friendswood, Webster and League City, there was an average net decline of six or seven feet and farther south in the localities of Dickinson, Texas City, La Marque, and Hitchcock, the average net decline was still greater.

The outstanding facts disclosed by the 5-year record of water level fluctuations are as follows: In the heavily pumped districts of the Houston-Pasadena area the artesian pressures declined, but the average decline was small; down the dip to the southeast of Houston the average decline was relatively large and the area in which the artesian pressures are depressed to or below sea level was materially expanded.

The chemical analyses and tests do not indicate that any important changes occurred from 1931 to 1936 in the chemical character of the water in the Houston-Pasadena area or in the territory between Houston and the Gulf.

The following conclusions are reached:

Considerable water is wasted in the Houston-Pasadena area and the elimination of this waste and of prodigal use of the water would go far toward solving the water supply problems of the area.

No large increase in pumping over the volume of water pumped in 1931 should be made within the city limits or along the ship channel between the city limits and Baytown.

In developing additional supplies of ground water, it would be advisable to go out from the city a sufficient distance to avoid undue interception of water that is moving toward the heavily pumped areas at Houston, Pasadena and Baytown, and replenishing the supply in those areas.

When additional pumping at the rate of 20,000,000 gallons a day is started at Pasadena, it appears probable that, locally, the present cone of artesian depression will be deepened to considerably more than 100 feet below sea level. This new cone of depression will expand to adjacent areas. The amount of lowering in any given direction from the new wells will decrease with distance from them and as the area affected expands the rate of expansion will decrease and the progress of the regional drawdown can be watched. A pronounced drop in head is to be expected during the spring of 1937 in all wells in the vicinity of Pasadena and probably also in the wells of southeastern Houston. Before the end of the summer a material decline in artesian head may occur in central and west central Houston 8 to 10 miles from the new project and necessitate the lowering of pumps in wells in which the present minimum water level during pumping is close to the suction limit of the pumps. With an adequate program of observations of water levels in wells, however, it should be possible to anticipate pronounced regional drawdown at these distances.

The possibility that a further large decline in the artesian pressures may result in the encroachment of water containing objectionable quantities of salt from the direction of the Gulf is to be feared. Such encroachment, if it does occur, fortunately is likely to be slow and the movement of the salt water can be watched.

The people of Houston need have no immediate serious apprehension regarding the effect of an increase of 20,000,000 gallons in the pumpage at Pasadena as ample time will be available in which to develop an additional water supply outside the Houston-Pasadena area. Plans toward that end, however, should be made at once.

The effect of pumping an additional 40,000,000 gallons a day at Pasadena is not discussed. If carried out, the pumpage from that vicinity, it is believed, would be greater than from almost any other area of equal size on earth. It would invite eventual disaster to the ground-water supply of the entire Houston-Pasadena area.

Important ground-water supplies are to be found in the territory west and southwest of the city in Harris County and a part of Fort Bend and Wharton Counties, north of the city in Harris and Montgomery Counties, and northeast of the city in Harris, Montgomery and Liberty Counties. Detailed information is given in the report regarding the yield of the wells and quality of the ground water in different parts of this territory, together with information indicating some of the advantages or disadvantages to be expected in the development of additional water supplies in the different sections.

The present water level observation program in the city and surrounding territory should be continued and materially expanded. Additional observation wells should be added and several of them equipped with continuous water stage recorders. This is especially necessary in the neighborhood of the new development. In certain critical areas where the observations are likely to have especial significance, existing unused wells, not now available should be cleaned out, deepened if necessary, and used for observation wells, or new wells should be put down for that purpose. The observation program should include frequent sampling and determination of the chloride content in the water from numerous carefully selected wells. The pumping inventory should be continued.

June 10, 1937. A pronounced decline in water levels has occurred in the observation wells of the Houston-Pasadena area since March First, 1937, following a large increase in the total pumpage. The average net decline for the year ending May, 1937, was as follows: 30 feet + near Pasadena, 11 feet in Southeast Houston, 7 feet in Northeast and Central Houston, 1 foot in North Houston and 1 foot in Southwest Houston.

INTRODUCTION

History of investigation, location and extent of area and previous reports

An investigation of the ground-water, or underground water, supply available for Houston and the region surrounding it has been in progress for several years, as part of a survey of the ground-water resources of Texas by the United States Geological Survey in cooperation with the State Board of Water Engineers, under the general direction of O. E. Meinzer, geologist in charge of the Division of Ground Water in the Geological Survey. The investigation has covered Harris, Galveston and Waller Counties, a large part of Montgomery, Fort Bend and and Brazoria Counties, and a small part of Liberty and Grimes Counties. Results of the investigation were set forth in mimeographed memoranda which were released October 17, 1932, and December 29, 1933. In the first memorandum it was shown that the water-bearing beds of sand tapped by the wells in the Houston district have an extensive outcrop area, that there is good evidence that the ground-water recharge by penetration of the rain that falls on this area is heavy, that the sands have a large aggregate capacity to transmit water, and that a state of essential equilibrium in artesian pressures had been reached in the Houston district.

The most significant fact brought out in the second memorandum is that there was a rise in the artesian head from the spring of 1931 to the spring of 1933 as a result of a moderate decrease in the rate of withdrawal from wells. In the summer of 1933 the investigation was interrupted because of a reduction in the State appropriation. In the spring of 1936 the sum of $1,500 was allotted by the City of Houston for further investigation, and this sum was matched by an equal sum by the U. S. Geological Survey. Between the summer of 1933 and the spring of 1936 monthly measurements of water levels in observation wells in the city were made by the Water Department of the City of Houston, and some measurements were made on the observation wells outside of the city by the Geological Survey in cooperation with the Board of Water Engineers.

In connection with earlier investigations, a study was made of the geochemical relations of the ground waters of an area about 25 miles wide and 90 miles long extending from Galveston northwestward through Houston, including a study of salt-water encroachment. A brief report on this subject relating to a part of the area, entitled "A study of salt-water encroachment in the Galveston area, Texas," by Samuel F. Turner and Margaret D. Foster, was published in the Transactions of the American Geophysical Union of the National Research Council for 1934, part 2, pp. 432-435.

In March, 1936, field work was resumed in making regular measurements on observation wells and in obtaining the rate of pumpage from the different producing wells, and studies of the chemical character of the well waters were continued with the special purpose of determining whether or not any material change had occurred in the character of the water during the preceeding three to five years. Samples were obtained from about 50 deep wells that had been previously sampled and these were tested for their contents of chloride, bicarbonate, and sulphate, and for their hardness. Samples were also analyzed from 27 deep wells, in the city and in areas northeast, southeast, south and west of the city, in Harris, Liberty, Montgomery and Fort Bend Counties, to supplement analyses of waters from 30 deep wells made in 1931 or 1932 or to give a comparison with later analyses.

The field work in March and April, 1936, was done by T. W. Bridges, whose untimely death occurred on April 30. Most of the later field work was done by J. F. Heuser.

Tables of well records, water level fluctuations in wells, drillers' logs and analyses of well waters. Hydrological map of the region.

Copies of a manuscript report from which this mimeographed release is taken are on file at the offices of the United States Geological Survey at Washington, the Texas Board of Water Engineers at Austin and the City Water Department at Houston. In the manuscript report are given the records of all the wells investigated in Harris, Galveston, Fort Bend, Brazoria, and Waller Counties, including the results of field tests of the water for chloride, sulphate, and hardness (table 1); the records of the water levels in observation wells in Harris, Galveston and Waller Counties (table 2); the highest water levels recorded in most of the observation wells in Houston in the spring of each year from 1931 to 1935 and the net rise or decline to 1936 (table 3); average quantities of water pumped by the City of Houston, 1923-36, in millions of gallons a day (table 4); total quantities of water pumped by the City of Houston, 1930-36, at each of the 9 pumping plants (table 4a); total quantities of water pumped from Houston wells not owned by the City (table 5); analyses or partial analyses of well waters in Harris, Galveston, Fort Bend, Brazoria, Waller and Liberty Counties (tables 6, 7, 8, 9, 10, 10a, 10b and 10c); and logs of selected deep wells (table 11). The fluctuations of the water levels in 21 of the observation wells are shown by graphs.

The map that accompanies the manuscript report shows the location of most of the wells in the region studied outside of Houston, the wells being given a number that corresponds to the number assigned to them in the tables. On this map, wells used for stock and domestic purposes and unused wells are indicated by a black circle, wells with pumping plants by a solid black dot, flowing wells by a blue circle, principal observation wells by a black half-arrowhead, wells for which water analyses or partial analyses are available by a green arrowhead, and wells that were tested for chloride, sulphate and hardness by a short green line. The approximate elevations above sea level to which the static water levels in deep wells would rise in 1936 is indicated by dashed red lines. These elevations are an index of the artesian pressures. The map, therefore, is an artesian pressure map besides a well map and shows approximately the amount and direction of the hydraulic gradient. This in turn indicates the direction of the underflow.

The tables and illustrations listed below accompany this mimeographed release.

Table 1. Water level fluctuations in observation wells (part of table 2 of manuscript report).

Table 2. Analyses of water from wells (part of table 6 of manuscript report).

Map 1. Map of Houston-Galveston area and adjacent region, Texas, showing location of observation wells, etc.

Map 2. Sketch map of Houston-Pasadena area, Texas, showing location of selected record wells.

Graphs of water level fluctuations in 21 observation wells.

GEOLOGY AND GROUND-WATER RECHARGE AND MOVEMENT

Discussions of the geology of the region and the conditions that affect ground-water recharge and movement are given in the report of October 17, 1932,1/ and will not be repeated in detail here. The most essential facts are as follows: Supplies of ground water in this region that are available at depths to which it is practicable to drill water wells occur in permeable beds of sand and fine gravel belonging, in ascending order, to the Lagarto clay, the unit consisting of the Goliad (?) sand, Willis (?) sand and Lissie formation, and the Beaumont clay. The sands are interbedded with relatively impermeable clay gumbo and shale and the beds dip generally to the south and southeast. Each of the formations except the Goliad has an outcrop area from which it extends toward the south or southeast beneath younger formations in general to progressively greater depths below the surface. Successively younger formations are therefore encountered in crossing the region from north to south or from northwest to southeast.

The Lagarto clay appears at the surface in the southern part of Grimes County, the northwestern part of Montgomery County and northern part of San Jacinto County, and is encountered at considerable depth at Houston. The thick sand members of the formation yield large quantities of water, usually somewhat hard but otherwise of good quality to deep wells in the central and southern parts of Waller and Montgomery Counties and in the northern part of Harris and Liberty Counties.

The Goliad sand does not crop out in the Houston district, its nearest appearance at the surface, known to the writers, being about 65 miles to the west near Eagle Lake in Colorado County; apparently it has been completely overlapped by younger formations for there is good evidence of its presence in subsurface in different parts of the district.

The Willis sand, and the Lissie formation crop out in broad zones covering the northern part of Harris County, the southern part of San Jacinto County, the northwestern part of Liberty County, and most of Waller and Montgomery Counties. Sands in the Lissie formation, and in the Willis (?) and Goliad (?) yield water to the wells of the Katy rice-growing districts and to most of the deep wells of the Houston and Pasadena areas.

The outcrop area of the Beaumont clay occupies the southern part of Harris County, the southern and eastern parts of Liberty County, and nearly all of Fort Bend, Brazoria, Galveston and Chambers Counties. The basal 200 feet of the formation consists largely of sand, but the upper and middle parts are largely clay. This member furnishes water to most of the large producing wells at Baytown, Texas City and Alta Loma and to shallow wells at Houston. The base of the formation which crops out immediately to the north of Houston is more than 1000 feet below the surface at Galveston.

The underground reservoirs formed by the permeable sands are replenished by rainfall on the outcrop areas of the sands and in a large part of these areas are filled to overflowing and spilling into the streams. In the 1932 report, 1/ it was concluded that the replenishment or recharge is comparatively heavy. This conclusion has been confirmed by subsequent observations of water level fluctuations in shallow wells on the outcrops. However, in most of the region the heavily pumped areas are remote from the outcrops of the sands that furnish water to the wells and the available supply is largely determined by the capacity of the sands to transmit water from the outcrops to the wells.

1/ Op. cit., p. 4.

The water moves slowly down dip and if not intercepted by wells eventually escapes through natural outlets, perhaps located in the Gulf of Mexico, or it may escape by slow movement into overlying beds. Such outlets must exist. The formations for the most part were deposited in the sea and were therefore once full of salt water. They now contain fresh water to relatively great depths, far down the dip, indicating movement has taken place, which would have been impossible if there were no deep-seated outlets.

The water-bearing sands are at higher elevations at their outcrop than they are at any place down the dip. On this account, and because the sands are interbedded with relatively impermeable clay, the water in them is under artesian pressure practically everywhere down the dip, even in areas close to the outcrop.

Map showing artesian pressures in underground reservoirs in 1936 and amount and direction of hydraulic gradients.

On the accompanying map of the Houston-Galveston area and adjacent region, lines are drawn showing the position above or below sea level to which water in wells 400 feet to 1800 feet or more in depth would rise in 1936. The lines are comparable with the contours on a topographic map, but instead of indicating the form of the land surface, they indicate the form of a surface represented by the water levels in wells. In most of the moderately deep to deep wells the water level is determined by the artesian pressure and the map therefore is essentially an artesian pressure map.

When wells were first put down in the region the artesian pressures practically everywhere were higher in the deeper wells than they were in the shallow wells. In the Houston, Pasadena, Baytown, Texas City, and Alta Loma areas this has been reversed as the result of heavy pumping from deep wells, and now the water level stands lower in the deep wells. North and west of Houston the deep well pressures still are greater and the water levels in wells from 800 or 1000 feet to 1500 feet or more in depth in the Lagarto clay and lower part of the Goliad (?) sand range from 25 to 40 feet higher than the water levels in wells 300 to 800 feet in depth in the upper part of the Goliad (?), the Willis (?) sand and the Lissie formation. For convenience, the difference, arbitrarily, has been assumed to be 35 feet, and on the map the contours north and west of Houston are indicated as 50 to 85 feet, 100 to 135 feet, and 150 to 185 feet, the larger number in each case representing the altitude of the water level in the deeper wells. At Houston and in the vicinity of Pasadena the lines represent most nearly the levels in wells 700 to 1300 feet deep in the Lissie, Willis (?), and Goliad (?) formations. South of Houston the lines at sea level and 20 feet above sea level are based on wells 475 to 900 feet deep in the Lissie formation, none of the wells studied in that area being of sufficient depth to penetrate to the deeper sands. Around La Porte and Baytown the lines represent the levels in wells from about 400 to about 1000 feet deep in the Lissie formation and Beaumont clay.

In the early days of well development the artesian head everywhere was above sea level, even, perhaps, in areas well out in the Gulf, and the lines of equal pressure probably were roughly parallel to the Coast, the 50 to 85 foot line passing through the southern part of Houston. The prevailing pressures now have been depressed below sea level in an area of several hundred square miles at Houston and east and southeast of Houston, and, as mentioned later in this report, the area of depression is still deepening and widening.

Water confined underground is not unlike water confined in a system of pipes; it will move in the direction of the hydraulic gradient. The gradients here have directions roughly at right angles to the lines shown on the map and the water everywhere is moving approximately in those directions. Originally the direction of movement throughout the region was from northwest to southeast approximately in the direction of the dip of the water-bearing formations and the first few wells put down at Houston intercepted water from only a small segment along the line of flow. Now, however, in some parts of the Houston, Pasadena and Baytown areas, the water is moving along the strike and up the dip of the water-bearing formations as well as down the dip.

FLUCTUATIONS IN WATER LEVELS IN OBSERVATION WELLS IN RELATION TO PUMPAGE

Fluctuations of the artesian pressures and water levels in wells when correlated with changes in the rate of ground-water withdrawals through wells provide the most accurate information available regarding changes in underground storage and the safe limits of ground-water use. The program of water-level measurements in wells undertaken in connection with the investigation in the Houston district and contiguous territory has been described in the mimeographed reports of October 17, 1932, and December 29, 1933. The record on many of the wells was started in the winter of 1930-31, and now covers almost six years. The measurements in the city wells and in a few wells in closely adjoining territory have been made monthly ever since the program was started. In most of the surrounding area, however, the monthly measurements were discontinued in the summer of 1933, and since then the measurements have been made at irregular intervals. The measurements in some of the wells have been discontinued because the wells have been sealed at the top or obstructed so that it is no longer possible to introduce a measuring tape.

Following is a discussion of the fluctuations in water levels in 63 observation wells of which 25 are located in Houston, 3 near Pasadena, 8 near Baytown (observations made by Humble Oil & Refining Co.), 1 at La Porte, 2 at South Houston, 2 at or near Genoa, 1 at Webster, 2 near Friendswood, 3 at or near Webster, 1 at La Marque, 3 near Hitchcock, 1 near Alta Loma, 1 at Texas City, 1 near Aldine, 1 at Spring, 1 at Humble, 3 on the Houston-Hempstead road and 4 in the rice-growing district near Katy. The water level measurements in these wells are given in the accompanying table and the fluctuations in 21 of the Houston and Pasadena wells are shown by the attached hydrographs.

The most consistent results can be obtained by comparing the maximum spring water levels. During the winter many wells are idle or are not pumped heavily, and local inequalities in artesian pressure produced by heavy pumping during the summer are gradually smoothed out. Therefore spring measurements of water levels in a group of observation wells are a more accurate index of pressures that exist generally in the underground reservoir than measurements at any other time. The discussion that follows is devoted chiefly to a comparison of the water levels in the spring of 1936 with those in the spring of 1931. Consideration is also given to changes in the rate of pumping from the well itself and from nearby wells that may have had an effect on the trend in pressures.

Fluctuations in Northwestern Houston

Well 590. City of Houston, Heights pumping station, 4½ miles northwest of Post Office. Depth, 1,332 feet.

The water level recorded in this well on February 20, 1936, was 9.35 feet lower than the level recorded on January 23, 1931, and on the average the levels recorded in February, March, April and May, 1936, were about 4 feet lower than those recorded in the corresponding months in 1932 (graph 1).

The observation well is an unused one and has not been in operation during the last six years. It is about 100 feet from one pumped well (Heights No. 3) and 600 to 800 feet from the other (Heights No. 5). The average quantities of water pumped at the station in million gallons a day from 1931 to 1936, inclusive, were approximately as follows: 1931, 2.9; 1932, 4.6; 1933, 4.1; 1934, 4.9; 1935, 5.1; 1936, 4.4.

Fluctuations in Central and South-Central Houston

Well 619. City of Houston, Lincoln Pool, Sabine Street, and Buffalo Drive, about 1 mile west of Post Office. Depth, 900 feet (?).

The water levels in this well were between 2 and 3 feet lower in the early spring of 1936 than they were in the early spring of 1931 (graph 6).

The well has not been used during the observation period of more than 5 years. So far as is known there are no pumped wells in its immediate vicinity, but it is less than one-half mile from the central pumping plant of the city, where the total pumpage in millions of gallons during 1930-1935 was as follows: 1930, 2653; 1931, 2789; 1932, 1784; 1933, 1692; 1934, 1782; 1935, 1870; 1936, 2369. It is on the western border of down-town Houston, an area in which there has been a material increase in pumpage during the last two years.

Well 673. M. K. & T. Railway Company. At railroad yards on North Main Street, 1 mile north of Post Office. Depth, 1,638 feet.

This well has not been used during the last six years, the water in it having become salty. The fluctuation in water levels disclosed by the record are erratic and probably do not reflect the true fluctuation of the artesian pressures in the fresh water-bearing sands.

Well 679. Houston Gas and Fuel Company, Commerce and La Branch Streets, one-half mile northeast of Post Office. Depth, 1,392 feet.

The water levels in this well were 3 to 4 feet higher in the spring of 1936 than they were in the spring of 1931. The well has not been used during the last six years. It is located on the west bank of Buffalo Bayou and is subject to flooding during high water. The fluctuations of water levels in it, therefore, may not reflect the true fluctuations in artesian pressure in the vicinity.

Well 680. Houston Electric Company, La Branch Street, one-half mile northeast of Houston Post Office. Depth, 1,350 feet +.

This is an unused well near Buffalo Bayou. The water level in it is very sensitive to the effects of pumping in neighboring wells and may be affected to some extent by the stage of the bayou. The record of water level fluctuations in the well, therefore, is believed to have little or no significance.

Well 790. Southern United Ice Company, Alameda and Cleburne Streets, 2 miles south-southwest of Post Office. Depth, 606 feet.

The water levels recorded in this well were about the same in the spring of 1936 as they were in the spring of 1931 (graph 9). The well was pumped in 1931, the average reported daily delivery amounting to about 140,000 gallons. The pumping plant was idle during 1932, 1933, and 1935, and was used for only a few days in 1934. It was shut down entirely in 1935, but was operated again a part of the time in the summer of 1936. The well is located in a district in which the total pumpage is not very heavy. It is, however, only about 1 mile northeast of the South End pumping plant, and about 1½ miles northwest of the Scott Street plant, the two most heavily pumped of the six plants now operated by the City. The total pumpage from those two plants in million gallons from 1931 to 1936 was as follows: 1931, 3321; 1932, 3654; 1933, 4091; 1934, 4493; 1935, 4553; 1936, 4377.

Well 853. Port City Ice Company, 2715 McKinney Street, one mile east-southeast of Houston Post Office. Depth, 650 feet.

The water level in this well was about one foot lower in February, 1936, than it was in February, 1931 (graph 7). The well has not been used during the last six years. It is, however, about 180 feet from a well belonging to the same company, which is reported to have been pumped at a rate averaging 50,000 gallons a day in 1931, but has not been operated since 1933. The well is close to the east border of down-town Houston, where there has been a considerable increase in pumpage during the last two years.

Well 738. Houston Packing Company, Navigation Boulevard, 1½ miles west of Houston Post Office. Depth, 417 feet.

The water levels in this well were about the same in the spring of 1936 as they were in the spring of 1931, and the fluctuations during the intervening period were comparatively small. The well has not been used during the last six years. It is located near another well, belonging to the Houston Packing Company, that is pumped almost continuously, the reported average daily pumpage in thousand gallons a day being as follows: 1931, 770; 1933 and 1934, 900; 1935 and 1936, 948. The water level in the observation well fluctuates only slightly with changes in the rate of pumping.

Well 741. Houston Electric Company, at car barns on Navigation Boulevard, 1¾ miles east of Post Office. Depth, 540 feet.

This well has not been used during the last six years. The record shows that the water level in it has declined persistently since the first measurement was made on January 8, 1931, the total decline to September 26, 1936, amounting to 8.21 feet (graph 8). This record is unlike that obtained at any other well in the Houston area. It is fairly clear that the well is shut off from the water-bearing sands that are tapped by the pumped wells in the vicinity, including the pumped well at the car bars, as otherwise it would be subject not only to seasonal rises and declines in water level but also to daily fluctuations.

Well 598. Brooks estate, near Eureka Junction, 4½ miles west-northwest of Houston Post Office. This is an unused well located about 4½ miles west-northwest of the Houston Post Office, at the western border of the city near Eureka Junction.

The water surface in the well reached the highest observed level in the spring of 1933 and was at about the same elevation in the spring of 1934 as it was in the spring of 1931 (graph 2), when measurements were begun. The well is an old one and its exact depth is not known but is reported to be several hundred feet. It is remote from any heavily pumped wells. The last measurement was made in June, 1934, when the well became obstructed.

Well 602. River Oaks Country Club, 4 miles west of Houston Post Office. Depth, 1,038 feet. The water levels recorded in this observation well were about the same in the spring of 1936 as they were in the spring of 1931 (graph 3), but lower than in 1932 and 1933.

The well is equipped with a 30 h. p. motor and turbine pump, and from 1931 to 1935 furnished all the water used for the club house, golf course and swimming pool, amounting to an average of about 240,000 gallons a day from May to October and about 20,000 gallons a day from November to April. During the summer of 1936 the supply for the swimming pool, amounting to about 40,000 gallons a day during the summer, was pumped from a new well about one-fourth mile distant. Most of the measurements were made on days when the pump was idle. None was taken while it was running.

No other wells are pumped in the vicinity, but the municipal West End pumping plant, the only large plant in this part of the city, is located about 1⅓ miles to the northeast. The total yearly pumpage from the West End plant in 1931, 1932, 1933 and 1934, amounted to 401, 389, 167, and 40 million gallons respectively. In 1935 the plant was not used.

Well 604. West End Ice Company, Heights Boulevard, about 2⅓ miles west-northwest of the Houston Post Office. Depth unknown, but reported to be around 400 feet.

The water level recorded in this well was about 2⅓ feet higher in April, 1936, than it was in April, 1931 (graph 4), but the average in the spring of 1936 was lower than the average in the springs of 1934 and 1935.

The well was pumped more or less regularaly during the summer of 1931 and 1932, the average reported daily pumpage amounting to 30,000 gallons. The pumping plant was shut down in the fall of 1932, and has not been operated since except for about two months in the summer of 1934. The West End pumping plant of the City of Houston is located about seven-eighths of a mile west of the well. As stated in the paragraph above relating to the River Oaks well (No. 602), the pumpage at the West End plant declined from a total of 401,000,000 gallons in 1931, to 40,000,000 gallons in 1934, and the plant was not operated in 1935 and 1936. On the other hand, pumpage by industrial plants within a mile of the Ice Company's well has increased materially since 1933, the largest increase, about 80,000 gallons a day, being at the plant of the Fidelity Products Company, located about three-fourths of a mile to the southwest.

Well 606. Henke and Pillot, Washington and Brown Streets, 2 miles west-northwest of Houston Post Office. Depth, 575 feet.

The record of water levels in this well show there was a net decline of about 3⅓ feet from the spring of 1931 to the spring of 1936 (graph 5). The well is unused but is within a few hundred feet of another well belonging to the Henke and Pillot Company that is regularly pumped, the reported average daily pumpage being 15,000 gallons in 1936. It is less than one-fourth mile from the plant of the Dickson Car Company, which in 1931 was supplied with water from a well belonging to the company, but is now supplied by the City. It lies between the West End and Central pumping plants of the City, being about 1¼ miles from the former and about 1⅓ miles from the latter.

Fluctuations in Southwestern Houston

Well 783. Houston Riding and Polo Club, Westheimer Road, 6 miles west of Houston Post Office. Depth, 350 feet.

Measurements of water levels in this well were started in July, 1932. The record shows that although the seasonal and yearly fluctuations have been rather small, the water levels in March, April and May, 1936, were about 2¾ feet lower than they were in the corresponding months in 1933 (graph 13).

The well is unused but is only about 8 feet from a well of about the same depth that is pumped occasionally to provide drinking water for club members and for horses. It is remote from any other pumped well.

Well 801. South Side Place, West University and Virginia Avenues, 5¼ miles southwest of Post Office. Depth, 600 feet.

The water level observations in this well were begun in January, 1931, and stopped at the close of 1935, when the well was sealed at the top so that it could no longer be measured. The water level fluctuations during the period were comparatively small. The recorded level in January, 1935, was about 1⅓ feet higher than that in January, 1931, and was about the same in November and December, 1935, as it was in the corresponding months in 1931. The well is used for public water supply in South Side Place, the reported average pumpage being 35,000 gallons a day from 1931 to 1935, and 55,000 gallons a day in 1936. It is comparatively remote from any other heavily pumped well.

Well 804. West University Place, 5⅓ miles west-southwest of the Houston Post Office. Depth, 650 feet.

The water levels recorded in this well averaged 2 feet lower in February, March and April, 1936, than they were in the corresponding months in 1932 (graph 12). The well has not been used during the last six years. It is located near two other wells that are pumped to supply water to West University Place, the average combined yield of which, in gallons a day, is reported to have been as follows: 1931, 90,000; 1933, 105,000; 1934 and 1935, 120,000; 1936, 140,000. No record was obtained of the pumpage in 1932. There are no other heavily pumped wells in the vicinity.

Well 809. Gem Electric and Ice Company, Bellaire, 7 miles southwest of Houston Post Office. Depth, 1,100 feet.

The water levels reported in this well were slightly lower in the spring of 1936 than they were in the spring of 1931 (graph 11). The well has not been used during the last six years. It is about 50 feet from a well 340 feet deep that is used for public water supply of Bellaire. The water level in the observation well shows no immediate effect from this pumping and is about the same when the pump is operated as it is when it is not operated.

Fluctuations in extreme Southern Houston

Well 820. Institute Place, 5½ miles south-southwest of Houston Post Office. Depth, 310 feet.

The water levels recorded in this well show a small but rather persistent decline (graph 10). The well is located on the open prairie south of the present city development. The nearest heavily pumped wells are at the South End plant of the City about two miles to the north.

Fluctuations in Eastern and Southeastern Houston

Well 759. Port City Compress Company, foot of Buchanan Street, 4¾ miles east of Post Office. Depth, 396 feet when drilled, deepened to 569 feet in November, 1932.

The water levels recorded in this well averaged about 5 feet lower in 1936 than they did in 1931 (graph 19) before the well was deepened, and the loss in head was due chiefly to the drop that occurred abruptly when the well was deepened. An average of only a few thousand gallons a day are pumped and apparently this draft has not changed materially during the last five years. No other heavily pumped wells are located within two miles of the well. As explained elsewhere the water level in well 881, 650 feet deep located about one mile to the southwest, was higher in the spring of 1936 than it was in the spring of 1931.

Well 868. Hughes Tool Company, Hughes and North Capitol Streets, 3 miles southeast of Post Office. Depth, 697 feet.

The water levels recorded in this well were about 3 feet lower in the spring of 1936 than they were in the spring of 1931. The well has been idle most of the time during the 5¾ years covered by the record. Two other nearby wells, owned by the Hughes Tool Company, supply water to the Company's plant and to the Gulf brewery, a few hundred feet distant. The well that supplies the brewery is only about 125 feet from the observation well and is about 1,100 feet deep. It has been pumped almost continuously since operations were started at the brewery (about January 1, 1934), at the reported rate of about 1,300,000 gallons a day. The other well, used to supply the tool plant, is about 300 feet from the observation well. Its reported production in gallons a day is as follows: 1931, 750,000; 1932, small; 1933 to 1935, 480,000; 1936, 1,440,000. The total reported pumpage at this plant in the spring of 1936 therefore was nearly 2,000,000 gallons a day greater than it was in the spring of 1931.

Well 878. Houston Compress Company, Anderson Clayton Turning Basin, 4⅝ miles southeast of Post Office. Depth, 905 feet.

The water levels recorded in this well were 2 to 3 feet higher in the spring of 1936 than they were in the spring of 1931. The well supplies water to the cotton compress works and to ships, but no records are available as to the amount used from 1931 to 1936. In 1928, the water supply was furnished by the City and according to meter readings, averaged about 140,000 gallons a day. So far as is known there has been no material change since 1931 in the pumpage from other wells that are within a mile of this well.

Well 881. Terminal Compress Company, 82d Street and Harrisburg Boulevard, 5½ miles southeast of Post Office. Depth, 650 feet.

The water levels recorded in this well in the spring of 1936 were slightly higher than they were in the spring of 1931 (graph 18). The well has not been used during the last six years. So far as can be learned there has been no material change in the pumpage in this locality since 1931.

Well 886. Bennett Oil Company (formerly Texas Alkali Works), San Antonio and Bowie Streets, 5½ miles southeast of Post Office.

The water levels recorded in this well in February and May, 1936, were about 6 feet lower than they were in the corresponding months in 1931 (graph 20). The pumpage from the well is reported to have averaged 10,000 gallons a day in 1931, and 23,000 gallons a day in 1935 and 1936. So far as known, there has been no material change in the rate of pumping from other wells in this locality since 1931.

Well 890. Texas Chemical Company, Magnolia Street, six miles southeast of Post Office.

This well has been in use most of the time since the early part of 1931. The water level fluctuation record therefore is a rather poor one. The water level was about the same on May 8, 1936, as it was on January 13 and April 6, 1931. The reported average yield of the well, in gallons a day, is as follows: 1931, 300,000; 1932, 230,000; 1933 and 1934, 300,000; 1935 and 1936, 400,000. The production of water from the well of the Deepwater Oil Refinery, less than one-fourth mile from this well, is also said to be greater in 1936 than it was in 1931, being reported as follows: 1931, 370,000; 1932, no record; 1933 and 1934, 400,000; 1935 and 1936, 420,000. Production from the well of the Bennett Oil Company, the only other pumped well within a mile, has also increased considerably (see discussion of well 886 above).

Well 898. City of Houston, Park Place, 6¾ miles east-southeast of Post Office.

This well was partly destroyed in the summer of 1935 and is no longer measurable. The last record was obtained June 18, 1935. The water levels recorded in January and April, 1935, were about a foot higher than those recorded in the corresponding months in 1931.

Well 900. Golf Crest Country Club, Telephone Road, 5½ miles east-southeast of Houston Post Office. Oil test well, depth, 2,560 feet, filled with mud to a level within 360 feet of the surface.

The water levels recorded in this well in the spring of 1931 were made while an adjoining well that supplies the golf course was being pumped, and apparently were abnormally low. Records obtained while the pump was idle indicate that the water levels were about 2 feet lower in the spring of 1936 than they were in the spring of 1932.

Fluctuations near Pasadena

Well 1170. Houston Light and Power Co., Deepwater plant, 8½ miles east-southeast of Houston Post Office, 1 mile northeast of Pasadena. Depth, 836 feet.

The observation well is one of three closely-spaced wells that supply water to the power station. The water level record is badly broken because the pump usually was running when it was visited by the observer. The few measurements that were made, however, indicate that the water level in the early part of 1936 was about as high as it was during the corresponding period in 1931 (graph 15). It is reported that on the average about 75,000 gallons a day was pumped at the plant in 1935 and that this rate of pumping has not varied materially since 1931. The well is less than a mile from the heavily pumped wells of the Sinclair Refining Company. The reported pumpage at the Sinclair plant from 1932 to 1935 in million gallons a day is as follows: 1932, 4.31; 1933 to 1935, 5.04; 1936 (first half), 5.1.

Well 1176. Texas Company Oil Refinery, Galena Park, 8½ miles east-southeast of Houston Post Office, about 2 miles north-northwest of Pasadena. Depth, 800 feet.

The water levels recorded in this well in the spring of 1936 were about the same as those recorded in 1931 (graph 21). The well has not been used during the last six years. It is located about one-half mile north of two wells that supply water to the oil refinery of the Texas Company. The reported average quantities pumped from the refinery wells in gallons a day from 1932 to 1935 were as follows: 1932, 345,000; 1933, 352,000; 1934, 390,000; 1935, 407,000.

Well 1196. Talford Jones, 13 miles southeast of Houston Post Office and 3 miles east of Pasadena. Depth, 550 feet.

Water level observations in this well were started in December, 1932. The water levels recorded in the spring of 1936 were about the same as those recorded in the spring of 1933. The well is practically unused, and there is no heavy pumpage near it. At the refinery of the Shell Petroleum Company, about 2⅔ miles to the northeast, the use of the following average quantities of ground water in million gallons a day is reported: 1933, 2.55; 1934, 2.64; 1935, 3.52; 1936, 3.50.

Fluctuations at La Porte

Well 1105. (Harris County). A. A. Womack, La Porte, about 23 miles east-southeast of Houston Post Office. Reported several hundred feet deep.

Water level observations were started in this well in December, 1932. The levels recorded in the spring of 1936 averaged about 3½ feet lower than those recorded in the spring of 1933. The average spring levels recorded during the four years are as follows: 1933, 53.0; 1934, 52.1; 1935, 53.54; 1936, 56.5.

According to report, this well formerly had a flow and when it was drilled, about 40 years ago, the artesian pressure was sufficient to raise the water 20 feet above the ground. The well is unused but is only a few hundred feet from a well that furnishes the public water supply for La Porte, amounting to the following average quantities in gallons a day, according to the municipal records: 1931, 311,000; 1932, 304,000; 1933, 318,000; 1934, 374,000; 1935, 500,000.

The well is across the bay and about four miles from the heavily pumped wells of the Humble Oil Refinery at Baytown.

Fluctuations at Baytown

Wells of Humble Oil Refinery at Baytown, 1051 to 1067 (Harris County). According to records kindly furnished by the Humble Oil and Refining Company, the water levels in the wells at the Baytown Refinery had declined in the spring of 1929 on the average to a depth of about 38 feet below sea level. The water levels became higher each spring during the succeeding 3 years and reached an average of 46 feet below sea level in the spring of 1932. They declined to about 56 feet below sea level in the spring of 1933, rose to about 47 feet in the spring of 1935, and declined to about 56 feet in the early spring of 1936. The water levels at the end of the 7-year period, therefore, were in about the same position as they were at the start.

During this period the average daily pumpage from the refinery wells reached a maximum of about 17 million gallons a day in 1929 and declined to a minimum of about 10,000,000 gallons in 1931. The average daily pumpage during the fall, winter and spring in 1935-36 was about 13,800,000 gallons, which, however, was about 2,900,000 gallons a day less than the average during the corresponding period in 1928-29.

The water levels in the spring of 1936, therefore, were correlated with considerably less pumpage than the levels in the spring of 1929.

Fluctuations at South Houston

Well 1203. (Harris County). Highway Department well at South Houston, about 11 miles southeast of Houston Post Office. Depth, 600 feet.

According to the comparatively few records of water levels in this well the levels in spring have become progressively lower since 1931, the net decline from 1931 to 1936 amounting to about 5 feet. The well is about 1,000 feet from a well that furnishes the public supply for South Houston, a small community with a population of about 600.

Well 1209. (Harris County). Firework Co., South Houston, about 11 miles southeast of Houston Post Office. Depth, 650 feet ±.

The record in this well was started in October, 1932. The water level in the spring of 1936 was about three feet lower than it was in the spring of 1932.

Fluctuations at Genoa

Well 1302. (Harris County). City of Genoa, at Genoa, about 14 miles southeast of Houston Post Office. Depth, 832 feet.

The spring measurements of water levels in this well show a progressive decline from 48.06 feet in 1931 to 53.91 feet in 1936 below the reference point. The well is not used but is near another well that supplies water to Genoa, a community with about 600 inhabitants. No heavy pumping is known within several miles.

Well 1312. (Harris County). T. C. Dunn. Depth, 885 feet. Unused rice irrigation well 2½ miles southwest of Genoa. The water level in this well was about 6 feet lower in the spring of 1936 than it was in the spring of 1931.

Fluctuations at Webster

Well 1360. Mrs. Fain. One-fourth mile east of Webster and about 22 miles southeast of Houston Post Office. Depth, 659 feet. The water levels in this well show a progressive decline below the reference point from 31.47 feet in April, 1931, to 38.70 feet in February, 1936. A well about 2 miles northwest of this well is pumped during the summer to irrigate rice.

Fluctuations at Friendswood

Well 1. (Galveston County). Garretson Estate, 8 miles west-northwest of League City. Depth, 600 feet. The water level in this well was 4.36 feet lower on February 28, 1936, than it was on May 9, 1933. On January 1, 1937, the level was at least 2 feet lower than it was on February 28, 1936, but its position was not exactly determined, the tape being stopped by an obstruction before water was reached.

Fluctuations at League City

Well 3. (Galveston County). Mrs. A. Voss, 5¾ miles west of League City. Depth, 763 feet.

The water level in this well was about 1⅓ feet lower on January 1, 1937, than it was on May 9, 1933.

Fluctuations at Dickinson

Well 112. (Galveston County). G. H. & H. Ry. Depth, 750 feet. Not used. The water level in this well was about 18 feet lower in the spring of 1936 than it was in the spring of 1931.

Well 113. (Galveston County). E. Monotti. Depth, 504 feet. Pumped with 2 h.p. engine for domestic use and stock. The water level in this well was about 4½ feet lower in the spring of 1936 than it was in the spring of 1933.

Well 115. (Galveston County). J. W. Palmer. Depth, 526 feet. The water level in this well dropped nearly 9 feet in the 3 years from the spring of 1933 to the spring of 1936.

Fluctuations at La Marque

Well 206. (Galveston County). A. J. Biron. Depth, 926 feet. The water level in this well was about 23 feet lower in the spring of 1936 than it was in the spring of 1931.

Fluctuations at Texas City

Well 228. (Galveston County). "Depot" well. Not used. Depth, 740 feet.

The water level in this well was about 7 feet below the surface in the spring of 1932. On January 28, 1937, it was more than 27 feet below. (On the latter date the well was obstructed and the tape could not be lowered below a depth of 27.2 feet.) The lowering of the water level in this well and in well 206 above probably was due in large part to heavy pumping at Texas City amounting in 1936 to an average of about 10,000,000 gallons a day. This is more than twice the amount pumped in 1931 and 1932. Most of the water is used by oil refineries.

Fluctuations at Hitchcock

Well 286. (Galveston County). A. Cook. Depth, 720 feet.

The water level in this well was about 8 feet lower in the spring of 1936 than it was in the spring of 1933.

Well 297. (Galveston County). Chas. Schiro. Depth, 720 feet. Equipped with 3 h.p. gas engine and pumped for domestic use and stock.

The water level in this well was about 8½ feet lower in the spring of 1936 than it was in the spring of 1933.

Well 300. (Galveston County). Chris Jonson. Depth, 500 feet. Not used.

The water level in this well was about 6 feet lower in the spring of 1936 than it was in the spring of 1933.

Fluctuations at Alta Loma

Well 272. (Galveston County). City of Galveston. Depth, 809 feet. Unused.

The water level in this well was about 3½ feet lower in the spring of 1936 than it was in the spring of 1933.

Fluctuations north of Houston, (near Aldine)

Well 264. (Harris County). Weary Farm, 3 miles north of Aldine and about 16 miles north of Houston Post Office. Depth, 1610 feet. The water levels recorded in this well show a continuous decline from 3 feet below the top of the casing in May, 1931, to 21.22 feet below in May, 1936. From May to September, 1936, the level rose about one-fourth foot, the only rise indicated in five years. The well is reported to have had a flow until 1930, the water coming from sand about 900 feet below the surface.

The well is located in a depression and is subject to flooding during exceptionally heavy rain. It is possible that silt has entered the casing at such times and partly sealed the sands thereby causing a decline in the artesian head. On the other hand the decline may have been due to heavy pumping from the deep sands at Houston and Pasadena. The well furnished water for stock when it flowed but has not been used since the flow ceased.

Fluctuations at Humble

Well 281a. (Harris County). City of Humble. Depth, 1140 feet. When this well was put down in 1934 it had a flow of 40 gallons a minute at a height of 21 feet above the ground. The well, and another one near it, 740 feet in depth, are heavily pumped for the public water supply of Humble. In December, 1936, it was flowing into a tank about 10 feet above the ground during periods when the pump was idle.

Fluctuations at Spring

Well 93. (Harris County). International and Great Northern R. R., at Spring, about 22 miles north of Houston, Depth, 984 feet.

When measured in the summer of 1936, this well had a flow of about 35 gallongs a minute and the artesian pressure was sufficient to raise the water about 25 feet above the ground. This is about the pressure recorded in the well when it was drilled, about 10 years ago.

Fluctuations northwest of Houston, along Houston-Hompstead Road

Well 206. (Harris County). R. B. Tucker. 20 miles northwest of Houston Post Office and 6½ miles southeast of Cypress. Depth, 450 feet.

The record for this well shows that the changes in water level during the last 5 years have been comparatively small.

Well 431. (Harris County). G. E. Wilkins, about 13 miles northwest of Houston and 2 miles west of Fairbanks.

This is a flowing well. Its depth is unknown but is said to be only a few hundred feet. However the high temperature of the water, 87° F., indicates that it may be 1500 feet or more in depth.

The discharge of the well was estimated at about 75 gallons a minute in 1931, when it was visited in connection with the ground water survey, and in 1936, when it was again visited, the discharge apparently was about the same. The well flows continuously and the water is unused except by stock.

Well 205. (Harris County). Humble Pipe Line Co., near Satsuma, about 20 miles northwest of Houston Post Office and about 6¼ miles southeast of Cypress. Depth, 700 feet.

The water levels recorded in this well in the spring of 1936 were about the same as those recorded in the springs of 1933 and 1934, but averaged about 3 feet lower than those recorded in the spring of 1931.

The well supplies the domestic needs and other moderate requirements at the pipe line station at Satsuma. It is pumped only occasionally.

Fluctuations in Katy rice-growing district

Well 362. (Harris County). E. G. Stockdick, about 4 miles northeast of Katy. Depth, 500 feet.

This well is used for rice irrigation and is reported to have a yield of about 1200 gallons a minute. The water level was about 3 feet lower in the spring of 1936 than it was in the spring of 1931.

Well 367. (Harris County). W. C. Hickman. 3¼ miles east-northeast of Katy. Depth, 535 feet. Used for rice irrigation, and is reported to have a yield of about 1100 gallons a minute. The water level was about 2⅓ feet lower in April, 1936, than it was in May, 1931.

Well 370. (Harris County). J. M. Johnson, about 3 miles east of Katy. Depth, 625 feet. Used for irrigation and reported to yield about 1600 gallons a minute. Water level was 2⅓ feet lower in April, 1936, than it was in March, 1931.

Well 384. (Harris County). A. J. Jordan, 6 miles northeast of Katy. Depth, 505 feet. Well does not yield much water, and is unused. Water level was about the same in the spring of 1936 as it was in the spring of 1931.

Summary of results of water level observations in wells

The results of the water level fluctuation measurements in the region are briefly summarized below.

In general the water levels in the Houston observation wells stood higher in the spring of 1932 than in the spring of 1931, and reached a maximum elevation for the 1931-36 period in the spring of 1933. Since 1933 there has been a general decline in the maximum levels and in most wells the maximum in the spring of 1936 was somewhat lower than the maximum in the spring of 1931, but on the average the difference amounted to less than 2 feet.

East of Houston, in the vicinity of Pasadena, the water levels in two observation wells were about the same in the spring of 1936 as they were in the spring of 1931.

East of Pasadena, at La Porte, there was a decline of about $3\frac{1}{2}$ feet from the spring of 1933 to the spring of 1936. Across the Bay from La Porte, at Baytown, the water levels showed practically no net decline from 1929 to 1936.

Northeast, north and northwest of Houston there are no deep wells within several miles of the city limits that can be measured. In this territory, therefore, no information is available as to whether or not there have been important changes in the artesian pressure. Farther out in these directions, 3 wells are flowing with no apparent decline in pressure, one at Humble, another at Spring and the third near Fairbanks. In one well near Aldine (No. 264) which had a flow until 1930, the water level has persistently declined but the decline may have been due to the entrance of muddy storm water into the well. Northwest of Houston on the Houston-Hempstead road near Satsuma the water level in a 700 foot well displayed a net decline of about 3 feet between 1931 and 1936, due, perhaps, to the effects of pumping from wells for rice irrigation a few miles to the south.

West of Houston, in the Katy rice-growing district in several wells, there was a decline of $2\frac{1}{2}$ to 3 feet from 1931 to 1936.

Southwest of Houston, at Bellaire, there was a net decline of about $2\frac{1}{2}$ feet from 1931 to 1936.

South and southeast of Houston, in the localities of South Houston, Genoa, Friendswood, Webster and League City, there was a net decline during the 5 years, amounting to 6 or 7 feet in several wells. Still farther south, in the localities of Dickinson, Texas City, La Marque and Hitchcock, a net decline was recorded that was the largest in the region, reaching a maximum of more than 20 feet. At Texas City and La Marque the decline probably was due in large part to the increased use of ground water by oil refineries at Texas City.

Of the 30 observation wells at Houston and Pasadena that have yielded the most satisfactory data, 5 are unused and are located a half mile or more from any heavily pumped well; 13 are unused but are only a short distance (in some instances less than 100 feet) from a well that is pumped a part of the time; 2 are pumped regularly during the summer but are not used very much during the winter and 10 are pumped more or less regularly, the most of them, however, being subjected to a heavier draft in summer than in winter. None of the wells was measured while the well itself was being pumped.

The water level fluctuation record in most of the wells of the Houston-Pasadena area must have been affected to a degree by pumping from the well itself, if it was pumped, or by pumping from nearby wells, as well as by regional changes in the artesian pressure. When the records are studied, however, the trend in the fluctuations is found to have a remarkable similarity. The seasonal fluctuations vary in amplitude but the yearly trends are about the same in most of the wells and the net gains or losses during the 5 year period are not greatly different. This can be most clearly seen by reference to the hydrographs. The conclusion is reached that the records reflect fairly well the changes in pressure for the entire Houston-Pasadena area.

The outstanding facts disclosed by the water level measurements are as follows: (1) The depression in the prevailing artesian head that existed in the most heavily pumped districts of Houston, Pasadena and Baytown, prior to 1931, was deepened scarcely at all between 1931 and 1936. (2) The depression in the prevailing artesian head that existed in the region south and southeast of Houston, prior to 1931, was materially deepened and widened between 1931 and 1936.

(See attached maps for location of observation wells.)

HOUSTON PUMPAGE, 1930-36

According to the records of the City Water Department, the average quantities of water delivered by the City between 1928 and 1936, in million gallons a day were as follows: 1928, 21.9; 1929, 23.0; 1930, 25.8; 1931, 25.4; 1932, 23.7; 1933, 23.5; 1934, 24.2; 1935, 24.4; 1936, 25.4.

A part of the results of studies that were made for the purpose of computing the production of water from wells in the Houston and Pasadena areas, other than those belonging to the City from 1930 to 1936, are given in table 5 of the manuscript report. In making the inventory of this independent pumpage, the yield of the well was measured if possible and the best available information was obtained regarding the operation of the pump over a period of years. Systematic pumping records, it was found, are seldom kept. Many of the pumps are electrically operated, but ordinarily, the pump is on the same electric motor as other machinery and no accurate information is to be had as to how the load is distributed. Often it is necessary to depend entirely upon the memory of the pump engineer or the plant manager for the pumping record, and sometimes when the statements of both are obtained they are found to differ materially. It is found that the general tendency of company officials, however, is to overestimate the yield of the pump and the length of the pumping periods. The figures on total pumpage given in the preliminary report of October 17, 1932, are believed to be somewhat too high, largely as a result of this tendency.

The figures in the table have been rated from A to E according to their probable accuracy, those designated "A" being the most accurate and those designated "E" the least accurate. All the figures except those rated "A" and "B", should be classed as estimates. While the data are not as accurate as could be desired, they nevertheless appear to justify the following conclusions: About 1930 the total pumpage from all wells in the area reached the maximum obtained up to that time. As the financial depression grew in 1931-33, the rate of pumping both from city and privately owned wells gradually declined and reached a minimum in 1933, but the decline amounted to only 10 or 12 percent of the pumpage in 1930-31. Since 1933 there has been a gradual increase in the pumping and the total in the latter half of 1935 and the first half of 1936 was not greatly different from the total during corresponding periods in 1930-31.

The upward trend in water levels in the Houston-Pasadena area between 1930 and 1933 was due to the reduced rate of pumping in most of the producing wells, and the decline in water levels since 1933 was chiefly the result of increased pumping. It is significant that the increase in pumping to a rate comparable with that at the start of the investigation has been accomplished with comparatively little average net loss in artesian head.

CHEMICAL CHARACTER OF GROUND WATER; FLUCTUATION IN CHARACTER

The following records of analyses of water from wells in the Houston region accompany the manuscript report:

Analyses of water from wells in Harris, Galveston, Waller and Fort Bend Counties, Texas, 1931-35 (Table 6); partial analyses of water from wells in the Houston district, Texas, 1936 (Table 7); partial analyses of water from selected deep wells in Houston, Texas, and in areas southeast, south and west of the city, 1936 (Table 8); results of a series of tests of chloride in well water at Houston (Table 9); results of a series of tests of chloride in well waters of Houston region (Table 9a); analyses of water from wells in the Humble-Crosby district in Harris County (Table 10); analyses of water from wells along the Humble-New Caney road in Montgomery County and at Cleveland and Hightower in Liberty County (Table 10a); analyses of water from wells at Stilson, Dayton and Liberty in Liberty County (Table 10b). The analyses given in tables 6 to 9a were made in the Water Resources laboratory of the U. S. Geological Survey at Washington by Margaret D. Foster. Those in tables 10 to 10b were made for the City of Houston in the laboratory of Rice Institute by A. J. Hartsook.

Analyses from representative wells in different parts of the region are given in the table of analyses herewith.

These records show that ground water of good quality is to be found in a large region surrounding Houston, as well as in Houston itself. In general, the water is hardest in the outcrop areas of the water-bearing sands and becomes progressively softer while the chloride in the water tends to increase with distance down the dip. For example: the water in the middle and lower parts of the Lagarto is of good quality in the northern part of Harris and Liberty Counties and in Montgomery County, but is salty in the vicinity of Houston; the water in the Goliad (?) sand and Willis (?) sand is of exceptionally good quality at Houston but is salty in the vicinity of Baytown.

The subject of the increase in the chloride content of the water with distance down the dip to the southeast of Houston is discussed at some length in the paper by Turner and Foster mentioned on page 4 entitled "Encroachment of salt water in the Galveston area, Texas". The information in that paper and other data obtained in the course of the investigation tends to show that at no great distance down the dip to the southeast of Houston the fresh water in the deep sands from which the city water supplies are largely obtained gives way to water that is too salty for municipal or industrial use.

As explained in the Turner-Foster paper, samples from 12 wells located in an irregular line from Houston southeastward to Texas City are being analyzed from time to time to determine whether or not the wells show any evidence of the encroachment of salt water, the last analysis being made in the summer of 1936. The series of tests of water from about 50 wells in the region referred to on page 4 were made for the same purpose. Comparison of the most recent analyses of samples from the 12 wells in the Houston-Texas City line with earlier analyses and the results of the chloride tests in 1936 with those made in 1931 and 1935 does not indicate any important change in the composition of the water. However, as stated later in this report, it must be recognized that a heavy increase in the rate of pumpage in the eastern part of Houston or in the vicinity of Pasadena, where the artesian head already has been depressed to 20 feet or more below the level of the sea may further lower the pressure to such an extent that water containing objectionable quantities of salt eventually will be drawn into the area from down the dip.

PROBABLE EFFECT OF ADDITIONAL HEAVY PUMPING IN THE VICINITY OF PASADENA

Industrial requirements have developed in recent months in the vicinity of Pasadena which, it is said, will necessitate an additional water supply of from 20,000,000 to 40,000,000 gallons a day. New wells have been put down which, it is said, have a combined capacity of 20,000,000 gallons a day. The pumping of these wells is to be started this month (March, 1937). What will be the effect of this great increase in the pumping draft on other wells in the area and on the underground reservoir as a whole ?

When additional pumping at the rate of 20,000,000 gallons a day is started, a deep cone of depression will quickly be developed in the immediate vicinity of the wells, all of which are located within an area of not more than 1 square mile. In one area of similar size in this region, the increase in the average daily pumping from about 10,300,000 gallons a day to about 14,200,000 gallons a day caused the average static water level to decline from about 46 feet below sea level in the spring of 1932 to about 68 feet below sea level in the spring of 1936, or a net decline of about 5.6 feet for each million gallons a day increase. In the Pasadena area the fresh water sands are materially thicker than in the area cited and, if the permeability of the sands is about the same, the rate of decline is likely to be materially less. Nevertheless, with an increase in pumpage of 20,000,000 gallons a day at Pasadena, it appears probable that locally the present cone of artesian depression will be deepened to considerably more than 100 feet below sea level. This new cone of depression will expand to adjacent areas. The amount of lowering in any given direction from the new wells will decrease with the distance from them, but as the area affected expands the rate of expansion will decrease and the progress of the regional drawdown can be watched. A pronounced drop in head is to be expected during the spring of 1937 in all wells in the vicinity of Pasadena and probably, also, in the wells of southeastern Houston. Before the end of the summer of 1937 a material decline in artesian head may occur in central and west central Houston 8 to 10 miles from the new project and necessitate the lowering of pumps in wells in which the water level during pumping is close to the suction limit of the pumps. With proper observations, however, it should be possible to anticipate pronounced regional drawdown at these distances.

The possibility that a further large decline in the artesian pressures may result in the encroachment of salt water is to be feared. Salty water occurs below the Houston-Pasadena area at depths of 3,000 to 3,500 feet, but this water is rather effectively confined by the thick clays of the Lagarto formation, and is not likely to rise into the wells. But chlorides in objectionable quantities probably occur only a few miles down dip in the deep horizons from which the largest supplies in the Houston-Pasadena area are now being pumped, and this water may move up the dip to this area. The recent extension of the cone of depression down the dip to the southeast of Houston adds to the apprehension on this score.

If, following over-pumping, salt water does move into the locality of greatest artesian depression, its movement, fortunately, is likely to be slow, and the movement can be watched. The contact, down the dip, between the fresh water and salt water, in all probability, is not abrupt, but is in the form of a zone of brackish water with a gradual gradation from fresh water to salt water. Moreover, further pronounced deepening of the cone of depression at first, is likely to increase the movement of water toward the depression from localities up the dip to the northwest of Houston faster than from localities down the dip, to the southeast, due to the fact that the water-bearing sands are more permeable up the dip and the hydraulic gradient is greater. The first result, therefore, of a heavy increase in pumping may be to decrease the chloride content of the water, and increase its hardness. This has already occurred in one of the most heavily pumped areas of this region. If salt water does enter the localities of over pumping, its spread to other parts of the area also is likely to be slow, and the movement can be watched. The people of Houston need have no immediate apprehension, as ample time will be available in which to develop an additional water supply outside the Houston-Pasadena area. Plans toward that end should, however, be made at once.

The effect of pumping an additional 40,000,000 gallons a day will not be discussed. If carried out, the pumpage in this vicinity, it is believed, would be greater than that from almost any other area of equal size on earth. It would invite eventual disaster to the water supply of the entire Houston-Pasadena area.

POSSIBILITIES OF DEVELOPING ADDITIONAL SUPPLIES OF GROUND WATER FOR THE HOUSTON-PASADENA AREA IN LOCALITIES OUTSIDE THE AREA

(See map 1 and tables)

In the 1932 report the following statement was made: "Further material lowering in head can be prevented and additional supplies can be obtained if, in the future, the city locates its new wells at greater distances from the existing cones of depression, preferably toward the west and southwest."

It is believed that the data now available from observations covering 5 to 6 years justify the following conclusions: No large increase in pumping over the volume of water pumped in 1936 should be made within the city limits or along the ship channel between the city limits and Baytown. Any large increase in ground-water withdrawals in or near the existing deep depressions in artesian pressure in down-town Houston and in the East Houston-Pasadena district would be especially undesirable. New wells involving heavy withdrawals of ground water should be located at distances of several miles from these depressions.

Large additional supplies are now needed by at least one industry, and a decision must be reached as to where these supplies can be obtained most economically and with least interference with present ground-water development. In considering the possibilities of obtaining additional supplies, it is necessary to keep the following facts in mind. Essentially there are three ground-water reservoirs in the region. The reservoir in the Beaumont sands occupies only the southern part of the area, the upper limit of the formation being along a northeast-southwest line that passes a few miles northwest of Houston. Below this line all four formations are present, the Beaumont slowly thickening down dip.

The reservoir formed by the Goliad (?) sand, the Willis (?) sand, and the Lissie formation is more or less effectively separated from the reservoir in the underlying Lagarto by thick, persistent clays belonging to the upper part of the Lagarto. In places thick, persistent clays in the Goliad (?), Willis (?), and Lissie separate to a degree the water supplies in the sands at different horizons. At Houston and from there southeastward the water is salty in the middle and lower sands of the Lagarto and contains objectionable amounts of chloride even in the uppermost sand. In the vicinities of Texas City and Alta Loma the water in the Goliad (?) sand, Willis (?) sand and Lissie formation is salty and the wells obtain their supplies from sands in the Beaumont clay. At Baytown the water in the Goliad (?), and Willis (?) is salty and the wells are supplied from the Lissie and the Beaumont.

Reserves of ground water of fair quality that are practically untouched occur in sands of the Lagarto clay west, north and northeast of Houston but relatively little is known regarding the extent of these supplies. Reserves are also available in the Goliad (?) sand, Willis (?) sand, and Lissie formation but in planning to develop them it would be advisable to go considerable distances from Houston in order to avoid the interception of water that is moving toward the heavily pumped areas and replenishing the supply in these areas. As mentioned on page 8 and indicated by the lines of equal artesian pressure shown on map 1, water is moving into parts of these areas along the strike and up the dip as well as down the dip.

In the paragraphs that follow, some of the advantages and disadvantages are cited of making new development in different directions from the city.

Northwest and north from Houston
(See map 1 and table of water analyses)

No additional ground-water supplies should be developed to the northwest or north of Houston, unless deep wells are put down and water is pumped only from the Lagarto sands or the wells are located far enough out to prevent serious interference with the wells of Houston and Pasadena, perhaps at least 20 miles from down-town Houston.

Some of the available data regarding deep wells northwest and north of Houston are summarized below.

Well 431, located about 2 miles west of Fairbanks, has a natural flow of water amounting to about 75 gallons a minute, having a temperature of 87 degrees Fahrenheit. The water is moderately high in dissolved mineral matter but is very soft. The depth of the well is reported as only about 800 feet but the high temperature of the water indicates that its depth may be 1500 feet or more. In such case the well may be drawing from a sand in the Lagarto clay.

According to field tests made near Satsuma, about half way between Fairbanks and Cypress, the water from a well 700 feet deep (No. 205) has a hardness of 220 parts per million while that from a nearby well about 400 feet deep (No. 206) has a hardness of about 400 parts per million.

Well 174, located 1½ miles southeast of Cypress, supplies water to the Houston hot well bathing and health resort. The well has a flow of about 50 gallons a minute of water that has a temperature of 104 degrees Fahrenheit and is very highly mineralized being particularly high in chloride. The well is reported to have a depth of 2,830 feet.

About 1¼ miles northwest of Cypress, a 400-foot well (No. 169) yields water that is relatively low in dissolved solids and is comparatively soft and fresh.

About 1 mile northeast of Cypress, an oil test well (No. 165), 1717 feet deep, has a flow of about 1 gallon a minute of water that is excessively high in chloride and contains some gas.

At Spring, about 25 miles north of Houston, water is obtained for locomotives and public use from well 93 belonging to the International and Great Northern Railway Company. This well has a flow of about 35 gallons a minute 4 feet above the ground and the artesian pressure is sufficient to raise the water about 25 feet above the ground. It is reported that during a pumping test in 1931 a yield of about 960,000 gallons a day was developed. The water contains a moderate quantity of dissolved minerals. According to the log, the sands penetrated by the well have a total thickness of about 300 feet.

Well 264, used as an observation well, is located along the International and Great Northern Railroad about 16 miles north of Houston. Until 1930 this well had a flow from a horizon reported as located about 950 feet below the surface and the water is said to have been of good quality.

Well 54, Montgomery County, is located near the north bank of Spring Creek about 26 miles north of Houston. The well belongs to Mr. C. L. Fitch and is reported to have a depth of 2285 feet. According to a field test made in 1931 the chloride and hardness in the water amounted to 60 and 150 parts per million, respectively.

Well 35, Montgomery County, is located close to the Houston-Conroe highway about 4¾ miles south of Conroe. The well belongs to Mr. W. T. Peoples, has a reported depth of about 350 feet, and on June 3, 1931, had a flow of about 9 gallons a minute. A field test on that date indicated that the chloride and hardness amounted to 35 and 110 parts per million, respectively.

Well 23, Montgomery County, belongs to the City of Conroe and is located at Conroe. The well has a total depth of 1221 feet and is equipped with screens at depths 1099 to 1163 feet and 1185 to 1221 feet. The chloride and hardness, according to a field test in 1931, amounted to 60 and 110 parts per million, respectively.

Well 28, Montgomery County, is located about ¾ mile southwest of Conroe. It belongs to the Delta Land and Timber Company, has a total depth of 1172 feet and is equipped with a screen from a depth of 1028 to 1148 feet.

Northeast from Houston

In this direction the nearest wells should be located at least 15 miles from down-town Houston and even at that distance should not tap the water in the upper sands which might eventually reach the wells in the vicinity of Baytown. In this direction from Houston there are comparatively few deep wells and considerable exploratory drilling may be needed before a conclusion can be reached as to whether or not adequate supplies of water of suitable quality can be obtained. Available data regarding the deep wells in the areas north and northeast from Houston and the character of the deep waters are briefly summarized below. The map shows the location of the wells and the results of analyses of the well waters are given in the table of water analyses. The distances given are estimated distances from the Houston Post Office.

Wells 281a and 281b are located at Humble, about 18 miles north of Houston. They belong to the City of Humble and are 1140 and 740 feet deep respectively. The deeper well is reported to have had a flow of 40 gallons a minute 21 feet above the ground and a pumping yield of 250 gallons a minute in 1934, when it was drilled. In December, 1936, when not pumped, it was discharging by natural pressure into a reservoir about 10 feet above the ground. The static water level in the shallower well remains at about 26 feet below the surface. This well is reported to have had an initial yield of 304 gallons a minute. The analyses indicate that the mineral content in the water from both of the wells is rather high and is similar in amount and character.

Wells 56 and 56a, Montgomery County, have a flow of water amounting to 3 or 4 gallons a minute, about one foot above the level of the ground in the first mentioned, and to about 20 gallons a minute, 6 feet above the ground in the other. These wells are located along the Humble-New Caney road about 5 miles north of Humble and about 23 miles northeast of Houston. The depth of one of these wells is reported as 992 feet. The temperature of the water in both wells is about normal for wells around 1000 feet deep in this region. According to the analyses the dissolved solids are relatively high but the water is comparatively soft.

At Cleveland, in Liberty County, about 45 miles northeast of Houston, the water supply for locomotives of the Gulf, Colorado and Santa Fe Railroad is obtained from a flowing well 1300 feet in depth. The well was first drilled to a depth of about 900 feet and developed a small flow at about the level of the ground. When it was deepened to 1300 feet, the artesian pressure increased materially and the well now has a flow thirty feet above the level of the ground. According to the analysis the water contains a moderate amount of dissolved solids and is relatively soft.

The public water supply of Cleveland is obtained from a well 386 feet deep belonging to the Gulf States Utilities Company. This water is considerably harder than that from the railroad well, but the total dissolved solids is less.

Along the north side of the Gulf, Colorado and Santa Fe Railroad, about 6 miles east of Cleveland and 1 mile west of Hightower station in Liberty County, there is an oil test that has a flow of water amounting to about 50 gallons a minute 5 to 6 feet above the ground. The well is located on land belonging to the B. E. Quinn estate, but nothing has yet been learned regarding its depth. The temperature of the water is relatively high and the well may be materially deeper than the railroad well at Cleveland, described above. The total quantity of dissolved solids in the water is moderately high but the water is quite soft.

About 8 miles east of Humble near the east bank of the San Jacinto River there is an abandoned oil test that has a barely perceptible flow about 1 foot above the ground. The well is located on the Frederick Rankin Survey and is known locally as the Black Cat oil test. The well may or may not be well No. 1 of the Humble Gulf Coast Oil Company which is on the same survey and has a total depth of 3557 feet. According to the log of that well, artesian water was struck in a bed of sand 32 feet thick between 2468 and 2500 feet. According to the analyses the water contains a moderate quantity of dissolved mineral matter. Further inquiry should be made to clear up the doubt as to the identity of the Black Cat well.

At Dayton in Liberty County about 33 miles northeast of Houston, the public water supply is obtained from a well 400 feet in depth. The water is somewhat highly mineralized.

At Liberty, county seat of Liberty County, about 40 miles northeast of Houston, the public water supply is obtained from 3 wells 650 to 685 feet in depth, all of which have a flow. The water is somewhat highly mineralized.

The swimming pool at Liberty is supplied from the natural flow of a well only 233 feet deep belonging to Mr. Fisher, manager of the cotton gin. The dissolved minerals in this water according to the results of the analyses are materially less than those in the waters of the deeper flowing wells at Liberty referred to above.

At the Stilson pumping station of the American Pipe Line Company, in Liberty County about 28 miles northeast of Houston, water is obtained from a well that is reported to have a depth of about 300 feet. The water is quite soft.

West and southwest from Houston

The territory west and southwest from Houston offers certain advantages as a field for obtaining additional ground-water supplies for the city. It is believed that new wells could be put down and pumped at moderate distances from the city in these directions with less effect on present wells at Houston, Pasadena and Baytown than would be produced by new developments at similar distances in other directions. Even in that territory, however, any new development should be located several miles west of the western limits of the city. The artesian head at Bellaire is about 60 feet below its original level and the area of depressed head undoubtedly is still progressing westward and southward, the rate of decline being rather slow, however, as it amounted only to $2\frac{1}{2}$ feet at Bellaire between 1931 and 1936. From the initial well a line of wells could be extended westward or southwestward, if necessary all the way to the Brazos River, or even beyond the Brazos, into the northern part of Fort Bend County and eastern part of Wharton County, although to do this would involve the heavy expense of constructing a pipe line across the river.

It is believed that wells almost anywhere in this territory will yield fairly large supplies. Wells of fair to large yield have been brought in in western and southwestern Houston. Some of the wells in the Katy rice district are reported to yield upwards of 1500 gallons a minute. Three wells at Sugarland have a reported combined yield of 2,000,000 gallons a day. Wells put down for rice irrigation west of the Brazos in Wharton County yield very large supplies of water.

The territory west and southwest of Houston includes the Katy rice-growing district, most of the rice wells being located within 6 or 8 miles of Katy. The total pumpage in the district was estimated as about 20,500 acre-feet in 1930 and 18,000 acre-feet in 1931--the equivalent of a continuous draft of about 18,000,000 gallons a day and 16,000,000 gallons a day respectively (1932 report, page 10). No figures are available as to the amount of water used in the district in 1936, but reports indicate that the total pumpage in that year was not greatly different from the pumpage in 1931. According to a statement by Mr. John Cope, one of the leading rice growers, the water level in the Katy district declined about 5 feet between 1903 and 1931 (1932 report, p. 13), and as mentioned in the present report in the section on water-level fluctuations a small decline occurred in a few wells in the district between 1931 and 1936. A further material decline in water levels undoubtedly will occur if heavy additional pumping is undertaken within several miles of the district.

The water in the deep well at Bellaire is relatively soft but in most of the territory west and southwest of Houston the water probably averages considerably harder than it does at Houston. The rice wells in the Katy district and the well along the railroad at Simonton yield rather hard water. The municipal wells at Richmond and Rosenberg yield water that is materially harder than the Houston water. (Records of wells, drillers logs and water analyses, Fort Bend County, west of Brazos River, a mimeographed report compiled by the Texas Board of Water Engineers under an allocation of funds from the Works Progress Administration.) The rice wells in Wharton County yield water that is relatively hard. (Unpublished data on water wells in Wharton County available for public reference in the open files of the State Board of Water Engineers at Austin and the U. S. Geological Survey at Washington.)

The Katy rice wells admit water from shallow as well as deep horizons. This is illustrated by the logs of wells 353 and 370, Harris County, in table 11, pages 6 and 7 of the manuscript report. At Sugarland the water from a well 1606 feet deep (well 54, Fort Bend County) in which the top of the principal water-bearing sand is reported to be 1505 feet below the surface, is quite soft, whereas the water from a well 733 feet deep (well 53, Fort Bend County) is quite hard. It is believed that much softer water could be obtained in the rice-growing areas and contiguous territory if the shallow ground water were cased off.

Presumably in all this area the water becomes softer toward the south and, on the whole, the strip of territory between the San Antonio and Aransas Pass Railroad and the Richmond road may offer the most favorable opportunities for development. The drilling should not proceed south of the Richmond road because of the possibilities that the chloride in the water is too high, or may become so with heavy pumping.

It should be pointed out that the development of additional supplies of well water for Houston in the territory to the northeast of the city would have this advantage: The conduit constructed to carry the well water to the city might later be used to convey water from the San Jacinto River or the Trinity River if it is decided to resort to one or both of these streams for a supplementary water supply.

Similarly, if new supplies of ground water were developed to the west-southwest of the city, the conduit constructed to convey the water to Houston might later be used to convey water from the Brazos River if it is decided eventually to make use of that stream.

IMPORTANCE OF CONTINUING AND EXPANDING THE PRESENT OBSERVATION PROGRAM

It was pointed out in a preceding section of this report that both the widening of the deep cone of artesian depression which additional heavy pumping is likely to produce, and the movement of salt water into the depression, if such movement does occur, can be watched and to a degree anticipated if proper observations are carried out. With this in mind the following recommendations are submitted:

The present water level observation program in the city and surrounding territory should be continued and materially expanded. Additional observation wells should be added and the wells should be measured weekly, at least for a time, after the new pumping starts. This is especially necessary in the neighborhood of the new development. Dependable information regarding artesian pressure fluctuations is being obtained from only 2 deep observation wells in the vicinity of Pasadena: well 1170, 836 feet deep, at the Deepwater plant of the Houston Lighting and Power Company; and well 1176, 800 feet deep belonging to the Texas Company. Well 1181, 691 feet deep, belonging to the Phillips Petroleum Company, Well 1183, of unknown depth, belonging to the Crown Oil Refinery, and one or more of the wells of the Sinclair Refinery Company (Nos. 1161-1167, 800 to 1301 feet deep), probably could be measured if a determined effort were made. Well 898 at the old East End plant of the City at Park Place should be cleaned out, deepened to not less than 1300 feet, and equipped with an automatic water-stage recorder. This is very important. The well is near the present East End plant and is in a direct line between Pasadena and the heavily pumped Scott Street and South End plants. If possible, an observation well 800 to 1,000 feet deep should be put down and equipped with a water-stage recorder a mile or so to the southeast of the Northeast plant from which an average of about a million gallons a day was pumped in 1936, in order that any further decline in pressure in that part of the area can be observed. The unused well at the North End plant should be equipped with a water-stage recorder. Several privately owned unused wells in central and east-central Houston should be equipped with water-stage recorders, if this can be arranged. The wells must be 8 inches in diameter or larger in order to admit a float of adequate size and, of course, the pumping equipment must be removed. The following wells are suggested (see table 1 in manuscript report): Well 677, depth 873 feet, screens set at 741-996 and 818-873 feet; well 605, 900 feet deep +, position of screens unknown; well 687, 1222 feet deep, screens set at 1279-1328 feet; well 854, 919 feet deep, screens set at 224-266, 366-382, 421-442, 542-564, 704-764 and 831-853 feet.

The observation program should include the frequent collection of samples of water and determination of their chloride content from numerous carefully selected deep wells in eastern Houston and Pasadena and in the areas south and southeast of Pasadena.

The pumping inventory should be continued without interruption, with a view to obtaining accurate information as to the current pumpage in each section and in the entire area. Without such information it is not possible to understand the significance of the fluctuations in artesian pressures and to reach a conclusion as to whether or not the available ground-water supplies are being materially depleted. For this purpose the cooperation of the owners or managers and engineers of the plants must be obtained. Such cooperation should not be difficult to obtain, once it is understood that the continuation of the pumpage inventory and other observations are of vital importance both to the owner of the plant and the whole community.

WASTE OF WATER; PROPOSED GROUND-WATER LAW

The availability of a large and convenient supply of ground water of good quality has been one of the major incentives for the location of industries in the vicinity of Houston and it is of the greatest importance that this resource should not be impaired. Most of the industrial firms make reasonable use of the water but others do not. For example, water employed for cooling machinery and air conditioning in some instances is used only once and then emptied into the sewer or nearest stream. The universal use of properly constructed cooling towers would greatly decrease the consumption of water. Considerable waste results also from the employment of methods of manufacture that involve unnecessarily large quantities of water. The elimination of this waste and prodigal use should go far toward solving the water-supply problems of the area.

The Texas State Planning Board is preparing a bill to submit to the current Legislature that is designed to stop the waste of underground water and henceforth to control the development of the available supplies so as to prevent them from being seriously depleted, while permitting the fullest use of the water that can be made with safety. One of the chief purposes of the proposed law is to protect the rights of the owners of wells that are now in use. This bill deserves the support of the people of Houston.

POSTSCRIPT
June 10, 1937

Since the above was written, records of water level measurements in wells have been accumulated for several additional months in the Houston-Pasadena area, the last measurement being made in well 1170 on June 5, 1937. These additional records have been incorporated in the table of water level measurements and graphs of water level fluctuations herewith.

About March 1 a battery of new wells was brought into operation near Pasadena and since then has been pumped almost continuously at the reported rate of about 19 million gallons a day. This represents an increase of around 40 per cent over the total maximum previous pumpage in the Houston-Pasadena area. Moreover, due to lack of rain, the pumpage by the City of Houston in May and the latter part of April, 1937, was materially heavier than it was during the corresponding period in 1936. The water levels in most of the observation wells in the area have responded to this increased draft and are materially lower than they were a year ago, the levels in wells 1170 and 1176 near Pasadena, for example, being more than 30 feet lower. In other parts of the area the average decline between May, 1936, and May, 1937, was approximately as follows in the deeper observation wells: 11 feet in Southeast Houston; 7 feet in Northeast Houston; 7 feet in Central, South Central and West Central Houston; 1 foot in Southwest Houston, 1 foot in North Houston.

TABLE 1

Water level fluctuations in observation wells in Houston-Pasadena area, Texas

Date	Depth to water (feet)
Well 590	
City of Houston, at Heights pumping station, 4½ miles northwest of Houston post office. Depth 1362 feet. Measuring point, top of pump base.	
1931 - Jan. 23 -	55.67
July 2 -	63.70
Aug. 12 -	69.21 b/
Sept. 9 -	67.83 b/
Nov. 3 -	65.54
Dec. 5 -	60.94 b/
1932 - Jan. 7 -	58.62 b/
Feb. 6 -	58.70 b/
Mar. 4 -	61.38
Apr. 8 -	60.06 b/
May 7 -	62.20
June 7 -	64.00
July 7 -	63.84
Aug. 8 -	66.28
Sept. 7 -	65.12
Oct. 8 -	62.90
Nov. 4 -	63.35
Nov. 29 -	60.87
Dec. 31 -	60.25 b/
1933 - Jan. 26 -	60.64 b/
Mar. 9 -	59.32 b/
Apr. 15 -	58.80 b/
May 12 -	59.45 b/
June 23 -	64.38 b/
Aug. 18 -	65.47 b/
Sept. 20 -	65.95 b/
Oct. 22 -	63.91 b/
Nov. 22 -	63.38 b/
Dec. 23 -	62.07 b/
1934 - Jan. 23 -	60.57 b/
Feb. 21 -	59.87 b/
Mar. 21 -	58.38 b/
Mar. 30 -	59.76
Apr. 20 -	59.24
May 22 -	59.88
June 26 -	66.79 b/
July 24 -	65.01
Aug. 16 -	65.51 b/
Sept. 22 -	66.30 b/
Oct. 23 -	65.75 b/
Nov. 21 -	62.52
Dec. 21 -	60.71
1935 - Jan. 31 -	64.11 b/
Mar. 1 -	62.20 b/
Mar. 22 -	62.25 b/
Well 590 -- Continued	
1935 - Apr. 24 -	63.05 b/
May 21 -	63.10 b/
June 19 -	65.14 b/
July 26 -	68.55 b/
Aug. 17 -	69.74 b/
Sept. 21 -	69.27 b/
Oct. 26 -	67.20 b/
Nov. 23 -	64.56 b/
1936 - Feb. 20 -	65.02 b/
Mar. 14 -	63.95 b/
Mar. 14 -	64.04 b/
Mar. 14 -	64.11 b/
Apr. 25 -	64.35 b/
May 9 -	64.77 b/
May 22 -	63.69 b/
July 24 -	64.79 b/
Aug. 26 -	63.90 b/
Well 598	
Brooks, 4½ miles west northwest of Houston post office, near Eureka Junction. Measuring point, top of casing at level of ground. Abandoned well.	
1931 - Mar. 20 -	43.80
May 26 -	43.38
July 2 -	44.00
Aug. 12 -	46.25
Sept. 9 -	47.41
Nov. 3 -	48.26
Dec. 5 -	47.37
1932 - Jan. 7 -	47.10
Feb. 6 -	45.42
Mar. 4 -	45.30
Apr. 8 -	44.82
May 7 -	44.63
June 8 -	45.48
July 7 -	45.94
Aug. 8 -	46.25
Sept. 7 -	47.43
Oct. 8 -	46.54
Nov. 28 -	45.15
Dec. 29 -	44.55
1933 - Jan. 31 -	42.51
Mar. 11 -	41.55
May 12 -	41.58
Aug. 18 -	47.26
Well 598 -- Continued	
1933 - Oct. 31 -	44.68
Nov. 22 -	44.50
Dec. 23 -	44.06
1934 - Jan. 23 -	43.06
Feb. 21 -	42.73
Mar. 21 -	42.42
Mar. 30 -	43.09
Apr. 20 -	43.64
May 22 -	43.91
June 26 -	45.90
July 24 -	Obstructed
Aug. 16 -	"
Sept. 22 -	"
Well 602	
River Oaks Country Club, 4 miles west of Houston post office. Depth 1038 feet. Measuring point, ½ inch hole in pump bowl, 2 feet above ground.	
1931 - Jan. 19 -	48.54
Apr. 7 -	47.10
May 21 -	48.05
July 2 -	51.56
Aug. 12 -	51.65
Sept. 10 -	52.29
Nov. 3 -	49.97
Dec. 5 -	48.48
1932 - Jan. 7 -	46.38
Feb. 6 -	45.14
Mar. 4 -	44.18
Apr. 8 -	43.22
June 7 -	a/
July 8 -	a/
July 9 -	48.09
Aug. 8 -	a/
Sept. 7 -	45.86
Oct. 5 -	a/
Nov. 7 -	44.00
Nov. 28 -	43.05
1933 - Jan. 2 -	42.16
Mar. 10 -	41.18
Apr. 15 -	41.00
Nov. 22 -	
Dec. 23 -	
1934 - Jan. 23 -	
Feb. 23 -	44.74

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 602 -- Continued	
1934 - Mar. 21 -	
Mar. 30 -	
Apr. 20 -	44.45
May 22 -	a/
June 26 -	a/
July 24 -	a/
Aug. 16 -	a/
Sept. 22 -	a/
Oct. 23 -	a/
Nov. 21 -	49.32
Dec. 21 -	47.11
1935 - Jan. 31 -	45.49
Mar. 1 -	
Mar. 22 -	a/
Apr. 24 -	a/
Apr. 29 -	47.34
May 21 -	46.84
June 19 -	a/
July 26 -	a/
Aug. 17 -	49.22
Sept. 21 -	a/
Oct. 26 -	a/
Nov. 23 -	48.62
1936 - Feb. 20 -	a/
Mar. 14 -	45.77
Mar. 14 -	46.70
Mar. 14 -	46.35
Mar. 16 -	45.82
Apr. 25 -	46.92
May 9 -	49.19
May 22 -	
July 24 -	49.34
Aug. 26 -	50.35
Sept. 26 -	a/
Nov. 23 -	49.47
Dec. 23 -	48.81
1937 - Feb. 1 -	46.17
Mar. 26 -	45.61
Apr. 27 -	a/
May 20 -	51.00

Well 604

West End Ice Co., Heights Boulevard, near H. & T. C. railroad crossing, 2⅔ miles west-northwest of post office. Measuring point, hole in 4-inch tee, 1.7 feet above ground.

Date	Depth to water (feet)
Well 604 -- Continued	
1931 - Jan. 23 -	71.34
Apr. 6 -	63.68
Nov. 3 -	64.80
Dec. 5 -	63.42
1932 - Jan. 7 -	62.00
Feb. 6 -	61.36
Mar. 4 -	60.60
Apr. 8 -	59.48
May 7 -	a/
June 7 -	a/
July 7 -	a/
Aug. 8 -	a/
Sept. 7 -	a/
Oct. 8 -	64.01
Nov. 4 -	61.07
Nov. 29 -	60.00
Dec. 31 -	59.51
1933 - Jan. 28 -	59.08
Mar. 9 -	58.38
Apr. 15 -	58.70
May 13 -	59.45
June 23 -	62.65
Aug. 18 -	61.09
Sept. 20 -	60.88
Oct. 31 -	58.46
Nov. 22 -	57.04
1934 - Oct. 23 -	60.47
Nov. 21 -	58.97
Dec. 21 -	57.27
1935 - Jan. 31 -	56.00
Mar. 1 -	55.48
Mar. 22 -	55.65
Apr. 24 -	59.55
May 21 -	59.75
June 19 -	61.13
July 26 -	62.54
Aug. 17 -	63.20
Sept. 21 -	62.70
Oct. 26 -	62.61
Nov. 23 -	57.37
1936 - Feb. 20 -	58.15
Mar. 14 -	58.90
Mar. 14 -	58.93
Mar. 14 -	58.93
Mar. 16 -	58.07
Apr. 25 -	61.10
May 9 -	61.94
May 22 -	61.86
July 24 -	65.34
Aug. 26 -	67.21
Sept. 26 -	68.54

Date	Depth to water (feet)
Well 604 -- Continued	
1936 - Nov. 23 -	65.98
Dec. 22 -	64.58
1937 - Feb. 1 -	63.42
Mar. 26 -	64.24
Apr. 27 -	65.29
May 19 -	67.57

Well 606

Henke and Pillot, Washington and Brown Streets, 2 miles west northwest of post office. Depth 575 feet. Measuring point, top of casing 6 inches above ground.

Date	Depth to water (feet)
1931 - Jan. 22 -	58.50
Apr. 6 -	55.96
May 25 -	57.63
July 2 -	59.86
Aug. 12 -	61.98
Nov. 3 -	65.69
Dec. 5 -	61.52
1932 - Jan. 7 -	60.10
Feb. 6 -	58.69
Mar. 4 -	57.92
Apr. 8 -	56.90
May 7 -	(60.72 b/
	(60.24
June 7 -	59.49 b/
July 7 -	60.18
Aug. 8 -	60.52
Sept. 7 -	60.74
Oct. 5 -	60.64
Nov. 4 -	59.55
Nov. 28 -	57.36
Dec. 31 -	56.53
1933 - Jan. 30 -	54.62
Mar. 9 -	56.25 b/
Apr. 15 -	53.46
May 13 -	54.33
June 23 -	58.12
Aug. 18 -	58.84
Sept. 20 -	59.08
Oct. 31 -	60.43
Nov. 22 -	59.75
Dec. 23 -	58.84
1934 - Jan. 23 -	57.80
Feb. 21 -	57.13

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 606 -- Continued	
1934 - Mar. 21	57.09 b/
Mar. 30	58.35 b/
Apr. 20	58.45 b/
May 22	58.63
June 26	51.75
July 24	64.40
Aug. 16	63.59
Sept. 22	63.73
Oct. 23	63.71
Nov. 21	63.63
Dec. 21	61.30
1935 - Jan. 31	59.96
Mar. 1	59.64
Mar. 22	60.39 b/
Apr. 24	59.39 b/
May 21	60.03
June 19	60.04
July 26	61.63
Aug. 17	62.67
Sept. 21	64.05
Oct. 26	63.67
Nov. 23	62.16
1936 - Feb. 20	59.96
Mar. 19	59.42
Apr. 25	60.46
May 9	61.25
May 22	61.27 b/
July 24	66.72
Aug. 26	69.95 b/
Sept. 26	72.01 b/
Oct. 27	70.99
Nov. 23	67.72
Dec. 22	65.23
1937 - Feb. 1	62.42
Mar. 26	63.80
Apr. 27	65.73
May 19	68.61 b/

Well 619

City of Houston. (Lincoln Swimming Pool.) Sabine Street and Buffalo Drive, 1 mile west of post office. Depth, 900 feet. Measuring point, top of casing. Abandoned well.

Date	Depth to water (feet)
1931 - Jan. 30	55.50
May 21	54.46
July 1	57.29
Sept. 10	60.00
Nov. 3	58.46
Dec. 5	56.45
1932 - Jan. 7	54.76
Feb. 6	53.65
Mar. 4	52.92
Apr. 8	51.25
May 7	52.10
June 7	54.73
July 9	55.86
Aug. 8	56.64
Sept. 7	57.23
Oct. 8	56.02
Nov. 4	54.68
Nov. 29	52.65
Dec. 31	51.72
1933 - Jan. 28	49.78
Mar. 10	48.95
Apr. 15	48.86
May 13	50.92
June 23	55.24
Aug. 18	57.12
Sept. 19	57.13
Oct. 31	56.72
Nov. 22	57.45
Dec. 23	56.70
1934 - Jan. 23	55.13
Feb. 21	54.83
Mar. 21	54.11
Mar. 30	54.65
Apr. 20	55.67
May 22	56.17
June 26	59.37
July 24	61.40
Aug. 16	61.81
Sept. 22	61.80
Oct. 23	61.29
Nov. 21	59.89
Dec. 21	58.13
1935 - Jan. 31	56.68
Mar. 1	56.57
Mar. 22	56.56
Apr. 24	55.84
May 21	56.77
June 19	57.33
July 26	58.64
Aug. 17	61.44
Sept. 21	61.63
Oct. 26	60.82
Nov. 23	59.40
1936 - Feb. 20	57.15
Mar. 16	56.90
Apr. 25	58.03
May 9	58.94
May 22	59.44
July 24	67.05
Aug. 26	73.25 b/
Sept. 26	75.10 b/
Oct. 27	74.72
Nov. 23	68.98
Dec. 22	64.87
1937 - Feb. 1	61.97
Mar. 26	63.38
Apr. 13	65.75
Apr. 27	66.52
May 19	68.80

Well 656

Texas Creosoting Co., Hardy St. and H. B. & T. railroad crossing, 4⅓ miles north of post office. Depth, 665 feet. Measuring point, top of pipe, 5 feet above ground.

Date	Depth to water (feet)
1931 - Jan. 9	62.68
Apr. 6	62.46
July 28	65.98
Nov. 3	67.00
Dec. 3	64.33
1932 - Jan. 8	a/
Feb. 6	62.86
Mar. 3	61.74
Apr. 8	62.51
May 7	a/
June 7	63.82
July 9	a/
Aug. 8	a/
Sept. 6	a/
Oct. 11	a/
Nov. 29	61.85
Dec. 31	a/
1933 - Jan. 27	59.95
Mar. 9	a/
Apr. 15	a/
May 12	59.45
June 22	a/
Aug. 19	64.42
Sept. 20	a/

a/ Pump running. b/ Pump running in nearby well.

Date	Depth to water (feet)
Well 656 -- Continued	
1933 - Nov. 22	62.20
Dec. 23	63.31
1934 - Jan. 23	62.61
Feb. 21	62.78
Mar. 21	62.47
Mar. 30	62.49
Apr. 20	a/
May 22	64.99
June 26	a/
July 24	67.97
Aug. 16	a/
Sept. 21	68.58
Oct. 22	68.23
Nov. 20	a/
Dec. 20	a/
1935 - Jan. 30	65.88
Feb. 28	65.46
Mar. 21	66.01
Apr. 23	a/
May 20	65.27
June 18	66.22
July 25	a/
Aug. 16	68.34
Sept. 20	68.38
Oct. 25	68.21
Nov. 22	a/
1936 - Feb. 19	a/
Mar. 19	63.58
Apr. 24	a/
May 9	65.89
May 22	a/
July 24	66.59
Aug. 26	67.99
Sept. 26	68.05
Oct. 26	67.25
Nov. 23	65.19
Dec. 22	64.89
1937 - Feb. 1	62.71
Mar. 26	a/
Apr. 27	66.93
May 19	68.09

Well 662

South Texas Cotton Oil Co., near junction of H. E. & W. T. and I. & G. N. railroads, 2¾ miles northeast of post office. Depth, 834 feet. Measuring point, top of pump base.

Date	Depth to water (feet)
Well 662 -- Continued	
1931 - Jan. 14	62.91
Apr. 6	61.82
July 3	65.87
Nov. 3	a/
Dec. 3	a/
1932 - Jan. 8	62.63
Feb. 6	60.68
Mar. 3	60.96
Apr. 8	a/
May 7	59.97
June 7	60.98
July 6	62.07
Aug. 8	63.05
Sept. 6	a/
Oct. 11	a/
Nov. 4	60.42
Nov. 23	59.63
1933 - Jan. 27	57.75
Mar. 9	a/
May 12	a/
June 22	a/
Aug. 19	a/
Sept. 20	63.61
Oct. 31	a/
Nov. 22	a/
Dec. 23	62.19
1934 - Jan. 23	61.91
Feb. 21	62.04
Mar. 21	61.31
Mar. 30	61.32
Apr. 20	a/
May 22	63.11
June 26	67.76
July 24	69.48
Aug. 16	a/
Sept. 21	68.00
Oct. 22	66.94
Nov. 20	66.35
Dec. 20	64.42
1935 - Jan. 30	63.61
Feb. 28	62.66
Mar. 21	62.58
Apr. 23	61.99
May 20	62.93
June 18	65.39
July 25	65.31
Aug. 16	a/
Sept. 20	66.47
Oct. 25	a/
Nov. 22	a/
1936 - Feb. 19	61.64
Mar. 19	60.52

Date	Depth to water (feet)
Well 662 -- Continued	
1936 - Apr. 24	61.82
May 9	62.25
May 21	67.53
June 22	63.91
July 24	65.09
Aug. 26	67.25
Sept. 26	a/
Oct. 26	a/
Nov. 23	65.32
Dec. 22	65.35
1937 - Jan. 1	60.33
Apr. 27	60.85
May 19	65.87

Well 663

South Texas Cotton Oil Co. Near junction of H. E. & W. T. and I. & G. N. railroads. 2¾ miles northeast of post office. Depth, 740 feet. Measuring point, top of pump base ⅓ foot above ground.

Date	Depth to water (feet)
1931 - Jan. 14	56.27
Apr. 6	54.91
Sept. 9	61.20
Nov. 3	a/
Dec. 3	a/
1932 - Jan. 8	a/
Feb. 6	56.10
Mar. 3	55.87
Apr. 8	55.82
May 7	54.83
June 7	56.03
July 9	58.83
Aug. 8	57.72
Sept. 6	59.65
Oct. 11	
Nov. 29	56.25
1933 - Jan. 27	53.96
Mar. 9	52.60
May 12	53.90
June 22	55.32
Aug. 19	56.28
Sept. 20	56.56
Oct. 31	56.25
Nov. 22	55.56
Dec. 23	54.10
1934 - Jan. 23	53.33

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 663 -- Continued	
1934 - Feb. 21	52.96
Mar. 21	52.94
Mar. 30	53.18
Apr. 20	53.49
May 22	53.52
June 26	56.01
July 24	57.44
Aug. 16	58.30
Sept.21	Sealed

Well 673

M. K. & T. Railway Co. yards, on North Main St., 1 mile north of post office. Depth, 1,638 feet. Not used. Measuring point, top of air line.

Date	Depth to water (feet)
1931 - Jan. 29	52.33
Apr. 7	44.43
May 20	52.75
July 16	56.84
Aug. 11	49.10
Sept.10	49.38
Nov. 3	46.95
1932 - Jan. 7	42.31
May 7	47.76
June 16	50.04
July 9	50.90
Aug. 8	54.12
Sept. 7	53.38
Oct. 8	52.24
Nov. 4	49.75
Dec. 27	45.37
1933 - Jan. 30	44.92
Mar. 11	44.15
Apr. 15	44.65
May 13	45.12
June 21	48.98
Aug. 18	50.80
Sept.19	50.87
Oct. 31	49.00
Nov. 21	47.42
Dec. 23	46.70
1934 - Jan. 23	44.82
Feb. 21	44.35
Mar. 21	44.98
Mar. 30	44.70
Apr. 20	45.64
May 22	45.53
June 26	49.66
July 24	51.29
Aug. 16	52.33
Sept.22	52.77
Oct. 22	50.24
Nov. 21	
Dec. 21	45.80
1935 - Jan. 31	44.27
Feb. 28	44.03
Mar. 22	43.78
Apr. 24	45.47
May 21	45.37
June 19	46.47
July 26	47.66
Aug. 17	48.16
Sept.21	47.93
Oct. 26	46.13
Nov. 23	42.68
1936 - Feb. 20	45.75
Mar. 19	45.60
Apr. 25	47.27
May 9	48.71
May 22	48.51
July 24	51.53
Aug. 26	55.57
Oct. 27	56.76
Nov. 24	53.43
Dec. 22	53.21
1937 - Feb. 1	50.39
Apr. 27	51.05
May 19	53.53

Well 678

Houston Gas & Fuel Co., Commerce and LaBranch Sts., ½ mile northeast of post office. Depth, 1392 feet. Measuring point, top of casing. Abandoned well.

Date	Depth to water (feet)
1931 - Jan. 7	27.74
Feb. 18	28.44
May 20	25.50
June 30	27.50
Aug. 11	27.91
Sept. 8	26.22
Nov. 2	26.07
Dec. 1	24.36
1932 - Jan. 7	23.25
Feb. 5	22.04
Mar. 3	21.00
Apr. 7	22.48
May 6	23.07
June 6	23.38
July 8	21.87
Aug. 5	21.66
Sept. 6	20.87
Oct. 10	21.55
Nov. 3	21.80
Nov. 28	22.19
Dec. 27	20.66
1933 - Jan. 27	20.84
Mar. 9	20.57
Apr. 15	21.60
May 11	22.06
June 22	22.03
Aug. 18	21.73
Sept.19	20.40
Oct. 30	20.90
Nov. 21	20.53
Dec. 21	21.57
1934 - Jan. 22	18.85
Feb. 20	18.51
Mar. 20	19.29
Mar. 30	20.60
Apr. 19	19.23
May 21	20.05
June 25	24.80
July 23	24.96
Aug. 15	23.05
Sept.21	23.64
Oct. 22	22.81
Nov. 20	23.18
Dec. 20	20.30
1935 - Jan. 30	21.91
Feb. 28	19.75
Mar. 21	19.58
Apr. 23	18.64
May 20	18.18
June 18	18.73
July 25	19.08
Aug. 16	19.23
Sept.20	19.93
Oct. 25	19.29
Nov. 22	18.77
1936 - Feb. 19	26.46

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 678 -- Continued	
1936 - Mar. 18 -	25.90
Apr. 24 -	23.11
May 7 -	21.89
May 21 -	24.50
June 22 -	27.95
July 24 -	27.44
Aug. 25 -	28.51
Sept.25 -	27.79
Oct. 26 -	31.42

Well 680

Houston Electric Co., La-Branch St. station, ½ mile northeast of post office, on Bayou. Depth, 1350 feet +. Measuring point, top of casing. Abandoned well.

1931 - Jan. 8 -	33.25
Feb. 18 -	27.35
May 20 -	40.33
May 30 -	44.74
June 30 -	47.24
Aug. 11 -	47.87
Sept. 8 -	46.50
Nov. 2 -	42.15
Dec. 1 -	40.03
1932 - Jan. 7 -	36.20
Feb. 5 -	40.53
Mar. 3 -	41.83
Apr. 7 -	42.93
May 6 -	36.91
June 6 -	37.80
July 8 -	41.85
Aug. 5 -	46.58
Sept. 6 -	37.46
Oct. 10 -	35.95
Nov. 3 -	38.00
Nov. 28 -	31.37
Dec. 27 -	29.67
1933 - Jan. 27 -	32.03
Mar. 9 -	29.92
Apr. 15 -	33.07
May 11 -	40.30
June 22 -	45.52
Aug. 18 -	45.84
Sept.19 -	43.95
Oct. 30 -	37.70

Date	Depth to water (feet)
Well 680 -- Continued	
1933 - Nov. 21 -	36.90
Dec. 21 -	35.40
1934 - Jan. 22 -	32.60
Feb. 20 -	34.82
Mar. 20 -	39.72
Mar. 30 -	36.96
Apr. 19 -	39.59
May 21 -	38.60
June 25 -	53.18
July 23 -	49.94
Aug. 15 -	50.21
Sept.21 -	48.82
Oct. 22 -	45.36
Nov. 20 -	43.77
Dec. 20 -	41.79
1935 - Jan. 30 -	46.10
Feb. 28 -	42.21
Mar. 21 -	43.05
Apr. 25 -	43.96
May 20 -	43.28
June 18 -	51.05
July 25 -	59.66
Aug. 16 -	60.01
Sept.20 -	57.34
Oct. 25 -	51.49
Nov. 22 -	47.50
1936 - Feb. 19 -	51.63
Mar. 18 -	49.72
Apr. 24 -	49.76
May 7 -	49.63
May 21 -	46.51
June 22 -	58.65
July 24 -	55.80
Aug. 25 -	58.00
Sept.25 -	52.24
Oct. 26 -	54.88
Nov. 24 -	56.11
Dec. 22 -	52.51
1937 - Jan. 27 -	50.74
Mar. 22 -	48.32
Apr. 26 -	57.08
May 19 -	63.56

Well 695

Harris County, Court House yard, 3 blocks north of post office. (6-inch casing.) Measuring point, top of air line. Abandoned well.

Date	Depth to water (feet)
Well 695 -- Continued	
1931 - Feb. 4 -	79.13
Apr. 7 -	78.91
May 20 -	80.97
June 24 -	85.95
Aug. 11 -	87.25
Sept. 8 -	86.99
Nov. 2 -	85.34
Dec. 1 -	81.40
1932 - Jan. 7 -	76.05
Feb. 5 -	72.28
Mar. 3 -	69.18
Apr. 7 -	78.80
May 5 -	78.32
June 6 -	79.90
July 8 -	83.11
Aug. 8 -	82.60
Aug. 28 -	73.87
Sept. 6 -	50.20
Oct. 10 -	77.23
Nov. 3 -	72.38
Nov. 28 -	71.92
Dec. 27 -	72.25
1933 - Jan. 27 -	75.16
Mar. 9 -	67.83
Apr. 15 -	75.10
May 11 -	77.12
June 22 -	81.73
Aug. 18 -	60.10
Sept.19 -	64.30
Oct. 28 -	70.36
Nov. 21 -	78.61
Dec. 21 -	49.62
1934 - Jan. 22 -	48.68
Feb. 20 -	47.66
Mar. 20 -	47.71
Mar. 30 -	47.77
Apr. 19 -	47.06
May 21 -	48.23
June 25 -	49.53
July 23 -	49.91
Aug. 15 -	50.47
Sept.21 -	51.85
Oct. 22 -	51.31
Nov. 20 -	51.50
Dec. 20 -	50.76
1935 - Jan. 30 -	49.79
Feb. 28 -	49.18
Mar. 21 -	48.97
Apr. 23 -	48.82
May 20 -	48.67
June 18 -	49.09

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 695 -- Continued	
1935 - July 25 -	49.85
Aug. 16 -	50.27
Sept.20 -	50.86
Oct. 25 -	50.76
Nov. 22 -	50.18
1936 - Feb. 19 -	48.10
Mar. 19 -	48.15
Apr. 24 -	48.78
May 7 -	49.00
May 21 -	49.26
June 22 -	49.63
July 24 -	50.59
Aug. 25 -	52.20
Sept.25 -	53.15
Oct. 26 -	53.61
Nov. 24 -	53.57
Dec. 22 -	53.50
1937 - Jan. 27 -	50.21
Mar. 22 -	52.04
Apr. 26 -	52.38
May 19 -	53.12

Well 738

Houston Packing Co., Navigation Boulevard, 1½ miles west of post office. Depth, 417 feet. Measuring point, top of casing--top of tee. Abandoned well.

1931 - Jan. 8 -	62.37
Apr. 6 -	62.83
May 6 -	
to Oct. 12 -	
Nov. 2 -	64.00
Dec. 1 -	63.86
1932 - Jan. 7 -	63.63
Feb. 5 -	63.46
Mar. 3 -	63.10
Apr. 7 -	62.89
May 6 -	62.65
June 6 -	62.43
July 8 -	62.47
Aug. 5 -	62.52
Sept. 6 -	62.60
Nov. 3 -	62.59
Nov. 28 -	62.52
Dec. 28 -	62.45
1933 - Jan. 27 -	62.00
Mar. 9 -	62.34
Apr. 14 -	61.44
May 11 -	61.29
June 22 -	61.34
Aug. 18 -	61.45
Sept.19 -	61.43
Oct. 30 -	61.53
Nov. 21 -	61.58
Dec. 21 -	61.56 b/
1934 - Jan. 22 -	61.43 b/
Feb. 20 -	61.08 b/
Mar. 20 -	60.81 b/
Mar. 29 -	60.76 b/
Apr. 19 -	60.68 b/
May 21 -	60.74 b/
June 25 -	60.97 b/
July 25 -	61.25 b/
Aug. 15 -	61.50 b/
Sept.21 -	61.63 b/
Oct. 22 -	62.15 b/
Nov. 20 -	62.33 b/
Dec. 20 -	62.31 b/
1935 - Jan. 30 -	62.32 b/
Feb. 23 -	62.30 b/
Mar. 21 -	62.28 b/
Apr. 23 -	62.32 b/
May 20 -	62.38 b/
June 18 -	62.46 b/
July 25 -	62.52 b/
Aug. 16 -	62.63 b/
Sept.20 -	62.86 b/
Oct. 25 -	63.07 b/
Nov. 22 -	63.15 b/
1936 - Feb. 19 -	62.93 b/
Mar. 18 -	62.90 b/
Apr. 24 -	63.02 b/
May 7 -	63.04 b/
May 21 -	63.06 b/
June 22 -	63.11 b/
July 23 -	63.25 b/
Aug. 25 -	63.52 b/
Sept.25 -	63.79 b/
Oct. 26 -	64.00 b/
Nov. 24 -	64.09 b/
Dec. 22 -	64.13 b/
1937 - Jan. 27 -	64.27 b/
Mar. 22 -	64.52 b/
Apr. 26 -	64.63 b/
May 19 -	64.78 b/

Well 741

Houston Electric Co., car barns on Navigation Blvd., 1¾ miles east of post office. Depth, 540 feet. Measuring point, top of air line. Abandoned well.

1931 - Jan. 8 -	47.95
Mar. 25 -	48.54
July 2 -	49.22
Aug. 12 -	49.61
Sept. 8 -	49.84
Nov. 2 -	50.24
Dec. 1 -	50.43
1932 - Jan. 7 -	50.65
Feb. 5 -	50.80
Mar. 3 -	50.92
Apr. 7 -	51.06
May 6 -	51.20
June 6 -	51.37
July 8 -	51.45
Aug. 5 -	51.70
Sept. 6 -	51.84
Oct. 10 -	52.00
Nov. 3 -	52.10
Nov. 28 -	52.26
Dec. 28 -	52.30
1933 - Jan. 27 -	52.12
Mar. 9 -	52.51
Apr. 14 -	52.62
May 11 -	52.54
June 22 -	52.86
Aug. 18 -	52.78
Sept.19 -	53.30
Oct. 30 -	53.45
Nov. 21 -	53.52
Dec. 21 -	53.62
1934 - Jan. 22 -	53.72
Feb. 20 -	53.75 b/
Mar. 20 -	53.81
Mar. 29 -	53.84
Apr. 19 -	53.88 b/
May 21 -	54.00 b/
June 25 -	54.10
July 23 -	54.23 b/
Aug. 15 -	54.34 b/
Sept.21 -	54.50 b/
Oct. 22 -	54.64 b/
Nov. 20 -	54.77 b/
Dec. 20 -	54.84 b/
1935 - Jan. 30 -	54.96 b/

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 741 -- Continued	
1935 - Feb. 28	55.00 b/
Mar. 21	55.05 b/
Apr. 23	55.12 b/
May 20	55.18 b/
June 18	55.26 b/
July 25	55.35 b/
Aug. 16	55.43 b/
Sept. 20	55.50 b/
Oct. 25	55.67
Nov. 22	55.72
1936 - Feb. 19	55.80
Mar. 16	55.76
Apr. 24	55.85
May 7	55.87 b/
May 21	55.89
June 22	55.92
July 23	55.98
Aug. 25	56.06
Sept. 26	56.16
Oct. 26	56.20
Nov. 24	56.23
Dec. 22	56.17
1937 - Jan. 27	56.24
Mar. 22	56.29
Apr. 26	56.30
May 19	56.32

Well 746

Texas and New Orleans Railway Co. creosoting plant on Liberty Road, 3¼ miles northeast of post office. Depth, 658 feet. Measuring point, end of 6-inch discharge pipe 4 feet above ground.

1931 - Jan. 12	63.17
July 3	64.74
Aug. 11	66.28
Sept. 9	67.05
Nov. 3	67.57 b/
Dec. 3	65.98
1932 - Jan. 8	64.62
Feb. 6	63.48
Mar. 3	62.35
Apr. 8	61.30
May 7	61.22 b/
June 7	62.18 b/
July 9	63.26 b/
Aug. 5	63.68 b/
Sept. 6	64.32 b/
Oct. 11	64.02 b/
Nov. 3	63.34
Nov. 28	62.42 b/
Dec. 28	61.45 b/
1933 - Jan. 27	61.27 b/
Mar. 9	59.31
Apr. 15	59.08 b/
May 15	Sealed

Well 751

Texas Pipe Line Co., Wallesville Road, 5¼ miles northeast of post office. Depth, 540 feet. Measuring point, top of air line 4.5 feet above ground. Abandoned well.

1931 - Mar. 19	54.11
May 25	54.87
July 3	56.11
Aug. 11	57.23
Sept. 9	58.13
Nov. 3	59.13
Dec. 3	57.71
1932 - Jan. 8	56.45
Feb. 6	55.49
Mar. 3	54.40
Apr. 7	53.28
May 6	53.26
June 7	53.82
July 9	54.72
Aug. 5	55.33
Sept. 6	55.58
Oct. 11	55.44
Nov. 3	55.00
Nov. 28	54.52
Dec. 28	53.76
1933 - Jan. 27	53.00
Mar. 9	52.34
Apr. 15	52.28
May 12	52.08
June 22	54.32
Aug. 19	55.96
Sept. 20	57.15
Oct. 31	58.18
Well 751 -- Continued	
1933 - Nov. 22	58.17
Dec. 23	57.99
1934 - Jan. 23	57.23
Feb. 21	56.85
Mar. 21	56.17
Mar. 29	56.23
Apr. 20	56.34
May 22	56.98
June 25	58.64
July 24	59.91
Aug. 16	60.56
Sept. 21	61.07
Oct. 22	60.89
Nov. 20	60.64
Dec. 20	59.49
1935 - Jan. 30	58.14
Feb. 28	57.38
Mar. 21	56.93
Apr. 23	56.56
May 20	56.29
June 18	56.56
July 25	57.29
Aug. 16	58.00
Sept. 20	59.35
Oct. 25	58.83
Nov. 22	58.08
1936 - Feb. 19	56.20
Mar. 16	55.68
Mar. 17	55.78
Mar. 17	55.75
Mar. 17	55.74
Apr. 24	56.07
May 9	55.99
May 21	55.99
June 22	56.93
July 24	57.87
Aug. 25	59.04
Sept. 26	59.86
Oct. 26	60.39
Nov. 23	59.43
Dec. 22	58.16
1937 - Jan. 27	56.34
Mar. 26	57.67
Apr. 27	60.18
May 19	62.77

Well 757

Layne-Texas Co., Market St. 4¼ miles east northeast of

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 757 -- Continued	
post office. Depth, 676 feet. Measuring point, pump base at level of ground.	
1931 - Feb. 25	57.61
Mar. 19	57.33
May 27	58.26
Sept. 9	62.00
Nov. 3	a/
Dec. 3	61.18
1932 - Jan. 8	59.40
Feb. 6	58.44
Mar. 3	56.90
Apr. 7	55.69
May 6	55.53
June 7	a/
July 9	a/
Aug. 5	a/
Sept. 6	a/
Oct. 11	57.92
Nov. 3	57.35
Nov. 28	a/
Dec. 28	56.12
1933 - Jan. 27	a/
Mar. 9	53.98
Apr. 15	53.72
May 12	a/
June 22	57.30
Aug. 19	59.81
Sept. 20	60.73
Oct. 31	61.90
Nov. 22	61.80
Dec. 23	61.61
1934 - Jan. 23	60.81
Feb. 21	60.12
Mar. 21	59.03
Mar. 29	59.21
Apr. 20	a/
May 21	60.20
June 25	
July 24	63.47
Aug. 15	64.08
Sept. 21	a/
Oct. 22	64.23
Nov. 20	63.82
Dec. 20	62.32
1935 - Jan. 30	60.91
Feb. 28	60.11
Mar. 21	59.74
Apr. 23	59.10
Well 757 -- Continued	
1935 - May 20	58.78
June 18	59.20
July 25	60.34
Aug. 16	60.89
Sept. 20	a/
Oct. 25	61.67
Nov. 22	60.84
1936 - Feb. 19	59.03
Mar. 16	58.10
Mar. 17	58.25
Mar. 17	58.30
Mar. 17	a/
Apr. 24	58.32
May 9	58.33
May 21	58.41
June 22	59.51
July 24	60.55
Aug. 2[illegible]	61.87
Sept. 26	62.65
Nov. 23	61.82
Dec. 22	Obstructed
1937 - Jan. 27	a/
Mar. 26	a/
Apr. 26	63.76
May 19	66.02
Well 759	
Port City Compress. Foot of Buchanan St., 4¾ miles east of post office. Depth, 396 feet. Measuring point, top of casing, 1¼ feet above ground.	
1931 - Feb. 26	56.85
July 3	59.28
Aug. 13	60.41
Sept. 9	60.98
Nov. 3	60.51
Dec. 3	59.63
1932 - Jan. 8	57.76
Feb. 6	a/
Mar. 3	a/
Apr. 7	56.13
May 6	55.95
June 7	a/
July 9	57.25
Aug. 5	a/
Sept. 6	56.83
Well 759 -- Continued	
1932 - Oct. 11	a/
Nov. 3	61.00
Nov. 28	60.70
Dec. 28	59.82
1933 - Jan. 27	59.26
Mar. 9	57.60
Apr. 15	57.67
May 12	58.17
June 22	a/
Aug. 19	64.36
Sept. 20	a/
Oct. 31	66.08
Nov. 22	a/
Dec. 23	a/
1934 - Jan. 23	64.52
Feb. 20	63.91
Mar. 20	62.26
Mar. 29	62.91
Apr. 19	63.05
May 21	63.99
June 25	66.23
July 23	67.56
Aug. 15	68.11
Sept. 21	68.37
Oct. 22	67.99
Nov. 20	67.43
Dec. 20	64.77
1935 - Jan. 30	64.39
Feb. 28	63.55
Mar. 21	63.26
Apr. 23	a/
May 20	62.38
June 18	63.10
July 25	64.14
Aug. 16	a/
Sept. 20	66.19
Oct. 25	a/
Nov. 22	64.50
1936 - Feb. 19	62.58
Mar. 16	61.80
Mar. 17	61.87
Mar. 17	61.88
Mar. 17	61.88
Apr. 24	61.80
May 9	a/
May 21	62.08
June 22	63.50
July 24	64.52
Aug. 26	65.67
Sept. 26	a/
Oct. 26	66.74

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 759 -- Continued	
1936 - Nov. 23 -	65.42
Dec. 22 -	63.79
1937 - Jan. 27 -	63.20
Mar. 26 -	64.98
Apr. 26 -	68.39
May 20 -	71.66

Well 783

Houston Riding & Polo Club. Westheimer Road, 6 miles west of post office. Depth, 350 feet +. Measuring point, top of casing, ½ foot above ground.

1932 - July 8 -	38.10
Aug. 8 -	38.57
Sept. 7 -	38.47
Oct. 5 -	38.54
Nov. 7 -	38.45
Nov. 28 -	38.25
1933 - Jan. 2 -	37.52
Jan. 30 -	36.98
Mar. 10 -	36.37
Apr. 15 -	36.27
May 13 -	36.44
June 23 -	37.36
Aug. 23 -	a/
Sept.18 -	38.16
Oct. 31 -	38.36
Nov. 22 -	38.40
Dec. 23 -	38.29
1934 - Jan. 23 -	37.87
Feb. 21 -	37.46
Mar. 21 -	37.37
Mar. 30 -	37.36
Apr. 20 -	37.10
May 22 -	37.17
June 26 -	38.77
July 24 -	39.75
Aug. 16 -	40.18
Sept.22 -	40.65
Oct. 23 -	40.59
Nov. 21 -	40.94 b/
Dec. 21 -	39.72
1935 - Jan. 31 -	38.96
Mar. 1 -	39.00
Mar. 22 -	38.86
Apr. 24 -	38.55
Well 783 -- Continued	
1935 - May 21 -	38.50
June 19 -	38.60
July 26 -	38.97
Aug. 17 -	39.30
Sept.21 -	40.16
Oct. 26 -	40.30
Nov. 23 -	39.94
1936 - Feb. 20 -	38.83
Mar. 14 -	39.07
Apr. 25 -	39.00
May 8 -	39.20 b/
May 22 -	39.57
July 24 -	40.32
Aug. 26 -	41.25
Sept.26 -	41.62
Oct. 27 -	41.77
Nov. 23 -	41.39
Dec. 23 -	40.80
1937 - Feb. 1 -	39.64
Mar. 26 -	39.41
Apr. 27 -	39.57
May 19 -	40.30

Well 790

Southern United Ice Co., Almeda & Cleburne Sts., 2 miles south-southwest of post office. Depth, 606 feet. Measuring point, top of casing, 1.5 feet below level of ground.

1931 - Jan. 17 -	57.04
Apr. 3 -	55.70
Sept.24 -	60.33
Nov. 3 -	59.28
Dec. 5 -	54.62
1932 - Jan. 7 -	
Apr. 8 -	51.03
May 7 -	51.10
June 16 -	52.46
July 9 -	53.19
Aug. 8 -	53.97
Sept. 7 -	54.61
Oct. 10 -	53.20
Nov. 28 -	51.42
1933 - Jan. 30 -	49.20
Mar. 8 -	48.95
Apr. 15 -	48.88
May 13 -	49.51
Well 790 -- Continued	
1933 - June 23 -	52.16
Aug. 23 -	a/
Sept.18 -	54.32
Oct. 31 -	53.90
Nov. 22 -	53.00
Dec. 23 -	52.66
1934 - Jan. 23 -	51.61
Feb. 21 -	51.03
Mar. 21 -	51.02
Mar. 30 -	50.78
Apr. 29 -	50.00
May 22 -	50.73
June 26 -	a/
July 24 -	a/
Aug. 16 -	a/
Sept.22 -	a/
Oct. 23 -	a/
Nov. 21 -	55.53
Dec. 21 -	52.75
1935 - Jan. 31 -	51.20
Mar. 1 -	
Mar. 22 -	53.12
Apr. 24 -	50.99
May 21 -	53.61
June 19 -	53.91
July 26 -	55.85
Aug. 17 -	57.90
Sept.21 -	58.76
Oct. 26 -	
Nov. 23 -	
1936 - Feb. 20 -	
Mar. 16 -	55.80
Apr. 25 -	
May 8 -	57.43
May 22 -	57.71
July 24 -	a/
Aug. 26 -	a/
Sept.26 -	a/
Nov. 23 -	61.35
1937 - Feb. 1 -	58.96
Mar. 26 -	60.05
Apr. 27 -	60.47
May 19 -	61.23

Well 801

South Side Place, University & Va. Sts., 5¼ miles southwest of post office. Depth, 600 feet +. Measuring

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 801 -- Continued	
point, top of cap, ½ foot above ground.	
1931 - Jan. 24 -	39.44
Nov. 3 -	39.53
Dec. 5 -	38.64
1932 - Jan. 7 -	a/
Feb. 6 -	37.59
Mar. 4 -	a/
Apr. 8 -	36.16
May 7 -	36.82
May 7 -	36.55
May 7 -	36.40
May 7 -	36.25
June 7 -	a/
July 8 -	37.15
Sept. 7 -	a/
Oct. 5 -	36.97
Nov. 7 -	36.48
Nov. 28 -	a/
1933 - Jan. 2 -	35.78
Jan. 30 -	34.96
Mar. 10 -	a/
Apr. 15 -	34.58
May 13 -	a/
June 23 -	36.92
Oct. 31 -	37.20
Nov. 22 -	a/
Dec. 23 -	37.25
1934 - Jan. 23 -	37.60
Feb. 21 -	a/
Mar. 21 -	37.65
Mar. 30 -	a/
Apr. 20 -	a/
May 22 -	a/
June 26 -	a/
July 24 -	a/
Aug. 16 -	a/
Sept. 22 -	a/
Oct. 23 -	39.91
Nov. 21 -	39.20
Dec. 21 -	38.78
1935 - Jan. 31 -	37.90
Mar. 1 -	a/
Mar. 22 -	a/
Apr. 24 -	a/
May 21 -	37.49
June 19 -	a/
July 26 -	a/
Aug. 17 -	a/
Sept. 21 -	a/
Oct. 26 -	39.02
Nov. 23 -	39.00
1936 - Feb. 20 -	Sealed

Well 804

West University Place, West University St., 5⅔ miles west-southwest of post office. Depth, 650 feet +. Measuring point, top of tee, 2½ feet above ground. Abandoned well.

1931 - Nov. 3 -	45.41
Dec. 5 -	43.98
1932 - Jan. 7 -	43.85
Feb. 6 -	42.70
Mar. 4 -	42.18
Apr. 8 -	41.05
May 7 -	41.15
June 7 -	41.90
July 8 -	41.85
Aug. 8 -	42.12 b/
Sept. 7 -	41.98
Oct. 5 -	42.02
Nov. 7 -	41.39
Nov. 23 -	41.10 b/
1933 - Jan. 2 -	40.41 b/
Jan. 30 -	39.70
Mar. 10 -	39.38
Apr. 15 -	39.35
May 13 -	39.80
June 23 -	40.67
Aug. 23 -	41.73
Sept. 18 -	42.00
Oct. 31 -	43.07
Nov. 22 -	43.12
Dec. 23 -	42.95
1934 - Jan. 23 -	42.74 b/
Feb. 21 -	42.68
Mar. 21 -	42.50
Mar. 30 -	42.29
Apr. 20 -	42.05
May 22 -	42.00
June 26 -	43.91 b/
July 24 -	
Aug. 11 -	
Sept. 22 -	46.47
Oct. 23 -	46.43
Nov. 21 -	46.46
Dec. 21 -	45.33
1935 - Jan. 31 -	44.54
Mar. 1 -	44.12 b/
Mar. 22 -	44.07
Apr. 24 -	43.74
May 21 -	44.01 b/
June 19 -	44.83 b/
July 26 -	43.73 b/
Aug. 17 -	44.66 b/
Sept. 21 -	47.31
Oct. 26 -	46.29 b/
Nov. 23 -	45.63
1936 - Feb. 20 -	43.94 b/
Mar. 16 -	43.97
Apr. 25 -	44.39 b/
May 8 -	44.70 b/
May 22 -	44.97 b/
July 24 -	45.49 b/
Aug. 25 -	46.55
Sept. 26 -	47.05 b/
Oct. 26 -	47.53
Nov. 23 -	46.58 b/
Dec. 23 -	46.16 b/
1937 - Mar. 26 -	42.82
Apr. 27 -	44.38
May 19 -	45.71

Well 809

Gem Electric and Ice Co., Bellaire, 7 miles southwest of Houston post office. Depth, 1100 feet +. Measuring point, top of casing, 4 feet above ground.

1931 - Feb. 16 -	43.60
Apr. 7 -	42.90
May 21 -	42.52 b/
July 2 -	43.60 b/
Aug. 12 -	44.52 b/
Sept. 10 -	45.00 b/
Oct. 20 -	45.84
Nov. 3 -	45.82
Dec. 5 -	45.18
1932 - Jan. 7 -	43.94
Feb. 6 -	43.23
Mar. 4 -	42.70

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 809 -- Continued	
1932 - Apr. 8	41.83
May 7	42.63 b/
June 7	42.92 b/
July 8	43.30 b/
Aug. 8	43.86 b/
Sept. 7	43.25 b/
Oct. 5	42.98 b/
Nov. 7	42.40 b/
Nov. 28	42.11
1933 - Jan. 2	41.37 b/
Jan. 30	40.86 b/
Mar. 10	40.52 b/
Apr. 15	40.36 b/
May 13	40.83 b/
June 23	41.82 b/
Aug. 23	42.76 b/
Sept.18	43.12 b/
Oct. 31	43.60
Nov. 22	43.55
Dec. 23	43.22
1934 - Jan. 23	42.83
Feb. 21	42.67
Mar. 21	42.91
Mar. 30	42.91
Apr. 20	42.64
May 22	43.02
June 26	44.71
July 24	45.84 b/
Aug. 16	46.44 b/
Sept.22	46.92 b/
Oct. 23	47.07
Nov. 21	46.75 b/
Dec. 21	46.09
1935 - Jan. 31	45.11
Mar. 1	44.69
Mar. 22	44.70 b/
Apr. 24	44.62
May 21	44.73
July 26	45.68 b/
Aug. 17	46.35
Sept.21	47.47
Oct. 26	47.32
Nov. 23	46.96 b/
1936 - Feb. 20	45.26
Mar. 16	45.00
Apr. 25	45.38
May 8	45.56
May 22	45.87 b/
July 29	46.35
Aug. 26	48.46 b/
Well 809 -- Continued	
1936 - Sept.26	48.70 b/
Oct. 27	48.92
Nov. 23	48.55
Dec. 23	47.94
1937 - Feb. 1	46.63
Mar. 26	45.84 b/
Apr. 27	46.09
May 19	47.36

Well 820

Institute Place, Almeda Road, 5½ miles south-southwest of Houston post office. Depth, 310 feet. Measuring point, top of casing, 0.4 foot above level of ground. Abandoned well.

Date	Depth to water (feet)
1931 - Sept.24	28.98
Nov. 4	29.44
Dec. 5	29.11
1932 - Jan. 7	27.24
Feb. 6	26.18
Apr. 8	28.20
June 10	28.95
July 9	28.73
Aug. 6	28.64
Sept. 7	28.30
Nov. 7	28.69
Nov. 28	28.77
1933 - Jan. 30	28.40
Apr. 15	27.50
May 13	28.23
Aug. 23	27.86
Sept.18	28.00
Oct. 31	28.10
Nov. 22	28.11
Dec. 23	28.25
1934 - Jan. 23	27.99
Feb. 21	27.59
Mar. 21	27.56
Mar. 30	27.54
Apr. 20	27.53
May 22	27.76
June 26	28.52
July 24	28.73
Aug. 16	
Sept.22	29.42
Oct. 23	29.64
Well 820 -- Continued	
1934 - Nov. 21	29.63
Dec. 21	29.59
1935 - Jan. 31	29.37
Mar. 1	29.11
Mar. 22	28.99
Apr. 24	29.28
May 21	29.17
June 19	29.80
July 26	30.66
Aug. 17	31.13
Sept.21	31.63
Oct. 26	31.28
Nov. 23	30.60
1936 - Feb. 20	29.88
Mar. 16	29.30
Apr. 25	30.51
May 8	30.45
May 22	30.24
July 24	30.34
Aug. 26	31.33
Sept.26	31.14
Oct. 27	31.08
Nov. 23	31.07
Dec. 23	30.39
1937 - Feb. 1	
Mar. 26	
Apr. 27	30.24
May 19	30.69

Well 853

Port City Ice Co., 2715 McKinney St., 1 mile east-southeast of post office. Depth, 650 feet. Measuring point, top of casing, 0.5 foot above ground.

Date	Depth to water (feet)
1931 - Jan. 8	71.25
Feb. 18	70.74
Apr. 6	69.89
June 30	76.12
Aug. 11	77.33
Sept.10	77.44
Oct. 13	75.35
Nov. 3	73.43
Dec. 3	70.26
1932 - Jan. 7	67.54
Feb. 6	65.72

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 853 -- Continued	
1932 - Mar. 4	64.94
Apr. 8	63.83
May 7	65.13
June 16	69.54
July 9	69.73
Aug. 8	71.62
Sept. 7	72.18
Oct. 10	69.25
Nov. 4	67.38
Nov. 29	65.80
1933 - Jan. 2	64.67
Jan. 28	62.90
Mar. 8	63.10
Apr. 14	63.65
May 11	64.24
June 21	67.12
Aug. 18	70.08
Sept.18	72.18
Oct. 31	74.23
Nov. 22	72.45
Dec. 21	71.77
1934 - Jan. 22	70.74
Feb. 20	69.77
Mar. 20	69.49
Mar. 30	68.57
Apr. 19	69.41
May 21	71.81
June 25	75.66
July 23	77.23
Aug. 15	78.06
Sept.21	77.96
Oct. 22	76.83
Nov. 20	75.64
Dec. 20	72.58
1935 - Jan. 30	70.19
Feb. 28	71.03
Mar. 21	70.69
Apr. 23	71.70
May 20	72.09
June 18	72.58
July 25	73.86
Aug. 16	76.26
Sept.20	76.86
Oct. 25	76.05
Nov. 22	73.94
1936 - Feb. 19	71.75
Mar. 16	71.02
Mar. 17	71.13
Mar. 17	71.33
Apr. 24	72.62
May 7	74.10
May 21	74.64
June 22	78.23
July 23	80.60
Aug. 25	83.25
Sept.25	34.25
Oct. 26	80.54
Nov. 24	75.79
Dec. 22	73.28
1937 - Jan. 27	71.98
Mar. 22	74.89
Apr. 26	78.32
May 19	81.86

Well 868

Hughes Tool Co., Hughes and North Capitol Sts., 3 miles southeast of post office. Depth, 697 feet. Measuring point, top of steel plate, 1 foot above ground.

Date	Depth to water (feet)
1931 - Jan. 8	50.25
Jan. 10	50.25
May 25	49.54
July 2	52.98
Aug. 12	54.40
Sept. 8	54.56
Nov. 2	52.07
1932 - Jan. 8	48.26
Feb. 5	47.18
Mar. 5	45.75
Apr. 7	44.57
May 6	45.79
June 6	47.24
July 8	48.50
Aug. 5	48.98
Sept. 8	49.20
Oct. 10	47.18
Nov. 3	45.80
Nov. 28	44.85
Dec. 28	43.71
1933 - Jan. 27	42.72
Mar. 9	42.26
Apr. 14	42.35
May 11	44.03
June 22	47.00
Aug. 18	
Sept.19	56.64
Oct. 30	57.11
Nov. 21	55.56
Dec. 21	55.02
Well 868 -- Continued	
1934 - Jan. 22	53.08 b/
Feb. 20	52.41 b/
Mar. 20	51.48 b/
Mar. 29	51.44 b/
Apr. 19	53.75 b/
May 21	57.50 b/
June 25	60.54 b/
July 23	62.29 b/
Aug. 15	63.06 b/
Sept.21	62.68 b/
Oct. 22	60.28 b/
Nov. 20	58.40 b/
Dec. 20	55.57 b/
1935 - Jan. 30	
Feb. 28	53.85 b/
Mar. 21	53.48
Apr. 23	56.24
May 20	56.67 b/
June 18	60.15 b/
July 25	
Aug. 16	
Sept.20	60.79
Oct. 25	
Nov. 22	
1936 - Feb. 19	
Mar. 16	52.75
Apr. 24	52.67
May 7	56.26
May 21	57.54
June 22	60.37 b/
July 23	62.29
Aug. 25	62.52 b/
Sept.25	64.24 b/
Oct. 26	60.31
Nov. 24	Obstructed
Dec. 22	65.82 b/
1937 - Jan. 27	57.47 b/
Mar. 22	57.44 b/
Apr. 26	59.81 b/
May 19	62.42 b/

Well 881

Terminal Compress Co., 82nd St. and Harrisburg Blvd., 5½ miles southeast of post office. Depth, 650 feet +. Measuring point, top of tee, 3.5 feet above ground.

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 881 -- Continued	
1931 - Jan. 21 -	54.35
July 2 -	57.57
Aug. 12 -	58.67
Sept. 8 -	59.29
Nov. 2 -	60.10
Dec. 1 -	56.97
1932 - Jan. 8 -	54.12
Feb. 5 -	53.46
Mar. 3 -	50.36
Apr. 7 -	48.44
May 6 -	48.67
June 6 -	49.84
July 8 -	51.38
Aug. 5 -	53.30
Sept. 6 -	51.28
Oct. 10 -	50.33
Nov. 3 -	50.00
Nov. 23 -	49.36
Dec. 28 -	49.21
1933 - Jan. 27 -	47.54
Mar. 9 -	46.68
Apr. 14 -	46.54
May 11 -	48.08
June 22 -	52.87
Aug. 18 -	55.93
Sept.20 -	57.88
Oct. 30 -	58.10
Nov. 21 -	57.87
Dec. 21 -	58.46
1934 - Jan. 22 -	56.44
Feb. 20 -	55.77
Mar. 20 -	53.47
Mar. 29 -	54.77
Apr. 19 -	54.95
May 21 -	55.56
June 25 -	58.15
July 23 -	59.73
Aug. 15 -	60.29
Sept.21 -	60.19
Oct. 22 -	58.60
Nov. 20 -	58.02
Dec. 20 -	55.66
1935 - Jan. 30 -	53.78
Feb. 28 -	52.60
Mar. 21 -	52.31
Apr. 23 -	51.12
May 20 -	50.33
June 18 -	51.40
July 25 -	52.54
Aug. 16 -	54.64
Sept.20 -	55.85

Date	Depth to water (feet)
Well 881 -- Continued	
1935 - Oct. 25 -	53.61
Nov. 22 -	
1936 - Feb. 19 -	51.65
Mar. 16 -	50.33
Mar. 17 -	50.48
Mar. 17 -	50.50
Mar. 17 -	50.50
Mar. 18 -	50.54
Apr. 24 -	49.86
May 7 -	49.36
May 21 -	50.16
June 22 -	51.36
July 24 -	52.53
Aug. 25 -	
Sept.25 -	
Yard locked	
Oct. 26 -	"
Nov. 24 -	"
Dec. 22 -	"
1937 - Jan. -	
Mar. 22 -	52.43
Apr. 26 -	58.60
May 19 -	61.93

Well 876

Houston Country Club, Harrisburg Blvd., $3\frac{3}{4}$ miles southeast of Houston post office. Measuring point, pump base, 0.2 foot above ground.

1931 - Jan. 16 -	51.36
Apr. 6 -	50.92
July 13 -	57.61
Nov. 2 -	57.14
Dec. 1 -	54.15
1932 - Jan. 8 -	51.29
Feb. 5 -	50.75
Mar. 3 -	47.00
Apr. 7 -	44.40
May 3 -	a/
June 3 -	47.52
July 8 -	a/
Aug. 5 -	a/
Sept. 6 -	48.87
Oct. 10 -	46.71
Nov. 3 -	44.42
Nov. 28 -	43.44
Dec. 28 -	42.66

Date	Depth to water (feet)
Well 876 -- Continued	
1933 - Jan. 27 -	41.85
Mar. 9 -	41.16
Apr. 14 -	
May 11 -	44.23
June 22 -	a/
Aug. 18 -	a/
Sept.19 -	56.33
Oct. 30 -	55.93
Nov. 21 -	55.39
Dec. 21 -	55.76
1934 - Jan. 22 -	52.28
Feb. 20 -	53.50
Mar. 20 -	53.00
Mar. 29 -	53.37
Apr. 19 -	Sealed
1937 - June 9 -	59.47

Well 878

Houston Compress Co., Anderson Clayton Turning Basin, $4\frac{3}{4}$ miles southeast of post office. Depth, 905 feet. Measuring point, top of pump base, 0.5 foot above ground.

1931 - Jan. 21 -	47.78
Apr. 6 -	46.97
May 25 -	49.42
Sept. 8 -	53.71
Nov. 2 -	53.78
Dec. 1 -	52.18
1932 - Jan. 7 -	47.73
Feb. 5 -	a/
Apr. 7 -	42.05
May 6 -	a/
June 6 -	43.68
July 8 -	46.09
July 8 -	45.93
July 8 -	45.80
Aug. 5 -	a/
Sept. 6 -	a/
Oct. 10 -	43.92
Nov. 3 -	44.54
Nov. 3 -	44.28
Nov. 3 -	44.04
Nov. 3 -	43.87
Nov. 28 -	a/
1933 - Jan. 27 -	a/

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 878 -- Continued	
1933 - Mar. 9 -	a/
May 11 -	a/
Aug. 18 -	a/
Sept.19 -	52.68
Oct. 30 -	a/
Nov. 21 -	52.65
Dec. 21 -	a/
1934 - Jan. 22 -	50.85
Feb. 20 -	51.47
Mar. 20 -	46.20
Mar. 29 -	a/
Apr. 19 -	49.05
May 21 -	a/
June 25 -	
July 23 -	54.71
Aug. 15 -	55.63
Sept.21 -	55.60
Oct. 22 -	56.74
Nov. 20 -	a/
Dec. 20 -	a/
1935 - Jan. 30 -	47.28
Feb. 28 -	a/
Mar. 21 -	46.12
Apr. 23 -	46.51
May 20 -	a/
June 18 -	47.28
July 25 -	49.33
Aug. 16 -	a/
Sept.20 -	49.89
Oct. 25 -	a/
Nov. 22 -	a/
1936 - Feb. 19 -	45.22
Mar. 18 -	43.78
Apr. 24 -	a/
May 7 -	47.84
May 21 -	45.16
June 22 -	47.94 ?
July 23 -	49.89
Aug. 25 -	49.34
Sept.25 -	52.01
Oct. 26 -	50.55
Nov. 24 -	46.97
Dec. 22 -	45.27
1937 - Jan. 27 -	43.76
Mar. 22 -	48.46
Apr. 26 -	55.07
May 20 -	58.24

Well 880

Bennett Oil Co., San Antonio and Bowie Sts., 5½ miles southeast of post office. Depth, 540 feet. Measuring point, top of casing.

Date	Depth to water (feet)
1931 - Feb. 3 -	54.70
Apr. 6 -	54.47
May 29 -	55.52
July 15 -	57.09
Aug. 12 -	58.04
Sept. 8 -	58.51
Nov. 2 -	58.00
Dec. 1 -	56.90
1932 - Jan. 8 -	55.61
Feb. 5 -	54.88
Mar. 3 -	54.21
Apr. 7 -	53.78
May 6 -	53.62
June 6 -	54.65
July 8 -	55.75
Aug. 5 -	55.81
Sept. 6 -	55.84
Oct. 10 -	55.54
Nov. 3 -	54.85
Nov. 28 -	54.25
Dec. 28 -	53.14
1933 - Jan. 27 -	52.38
Mar. 9 -	51.79
Apr. 14 -	51.75
May 11 -	52.70
June 22 -	55.88
Aug. 18 -	56.73
Sept.20 -	58.62
Oct. 30 -	a/
Nov. 21 -	a/
Dec. 21 -	58.68
1934 - Jan. 22 -	57.67
Feb. 20 -	57.47
Mar. 20 -	57.64
Mar. 29 -	57.29
Apr. 19 -	57.54
May 21 -	60.48
June 25 -	63.47
July 23 -	65.78
Aug. 15 -	70.62
Sept.21 -	67.60
Oct. 22 -	66.29
Nov. 20 -	63.18
Dec. 20 -	a/

Date	Depth to water (feet)
Well 886 -- Continued	
1935 - Jan. 30 -	a/
Feb. 28 -	61.35
Mar. 21 -	60.81
Apr. 23 -	a/
May 20 -	62.92
June 18 -	63.10
July 25 -	65.80
Aug. 16 -	67.47
Sept.20 -	68.62
Oct. 25 -	67.55
Nov. 22 -	a/
1936 - Feb. 19 -	61.39
Mar. 18 -	a/
Apr. 24 -	a/
May 8 -	61.55
May 21 -	61.41
June 22 -	64.31
July 23 -	65.66
Aug. 25 -	67.20
Sept.25 -	67.30
Oct. 26 -	67.51
Nov. 25 -	66.70
Dec. 25 -	a/
1937 - Jan. 27 -	a/
Mar. 22 -	65.06
Apr. 26 -	67.73
May 19 -	a/

Well 890

Texas Chemical Co., Magnolia St., 6 miles southeast of post office. Depth, 1,284 feet. Measuring point, base of pump, 1.5 feet above ground.

Date	Depth to water (feet)
1931 - Jan. 13 -	68.90
Apr. 6 -	68.08
July 13 -	73.41
Nov. 2 -	76.68
Dec. 1 -	72.12
1932 - Jan. 8 -	69.05
Feb. 5 -	66.85
Mar. 3 -	a/
Apr. 7 -	65.25
May 6 -	a/
June 6 -	64.74
July 8 -	a/
Aug. 5 -	a/

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 890 -- Continued	
1932 - Sept. 6 -	65.70
Oct. 10 -	a/
Nov. 3 -	a/
Nov. 28 -	64.32
Dec. 28 -	65.45
1933 - Jan. 27 -	a/
Mar. 9 -	a/
Apr. 14 -	61.75
May 11 -	a/
June 22 -	a/
Aug. 18 -	67.23
Sept.20 -	a/
Oct. 30 -	a/
Nov. 21 -	a/
Dec. 21 -	a/
1934 - Jan. 22 -	a/
Feb. 20 -	70.77
Mar. 20 -	70.63
Mar. 29 -	a/
Apr. 19 -	a/
May 21 -	a/
June 25 -	74.61
July 23 -	75.92
Aug. 15 -	a/
Sept.21 -	a/
Oct. 22 -	a/
Nov. 20 -	a/
Dec. 20 -	a/
1935 - Jan. 30 -	a/
Feb. 28 -	a/
Mar. 21 -	a/
Apr. 23 -	a/
May 20 -	a/
June 18 -	a/
July 25 -	a/
Aug. 16 -	a/
Sept.20 -	a/
Oct. 25 -	70.16
Nov. 22 -	a/
1936 - Feb. 10 -	a/
Mar. 19 -	a/
Apr. 24 -	a/
May 8 -	69.15
May 21 -	a/
July 24 -	a/
Aug. 25 -	a/
Sept.25 -	a/
Oct. 26 -	a/
Nov. 24 -	a/
Dec. 22 -	Obstructed
1937 - Jan. 27 -	63.70
	Motor cold

Date	Depth to water (feet)
Well 890 -- Continued	
1937 - Mar. 22 -	72.90
	Motor warm
Apr. 26 -	77.68
May 19 -	80.95
	Motor cold

Well 898

City of Houston. Park Place, 6¾ miles east-southeast of post office. Measuring point, top of bushing in air line. Abandoned well.

1931 - Jan. 8 -	58.50
Apr. 6 -	57.52
July 13 -	60.61
Aug. 13 -	61.08
Sept. 8 -	61.79
Nov. 2 -	62.71
Dec. 1 -	60.63
1932 - Jan. 8 -	58.40
Feb. 5 -	57.60
Mar. 3 -	56.17
Apr. 7 -	54.35
May 6 -	54.55
June 6 -	55.54
July 8 -	56.78
Aug. 5 -	57.42
Sept. 6 -	57.18
Oct. 10 -	56.80
Nov. 3 -	56.30
Nov. 23 -	56.16
Dec. 28 -	55.27
1933 - Jan. 27 -	54.17
Mar. 9 -	53.42
Apr. 14 -	53.28
May 11 -	54.30
June 22 -	57.30
Aug. 18 -	58.91
Sept.20 -	59.77
Oct. 30 -	61.06
Nov. 21 -	61.17
Dec. 21 -	61.45
1934 - Jan. 22 -	60.71
Feb. 20 -	60.31
Mar. 20 -	59.01
Mar. 29 -	59.24
Apr. 19 -	59.13
May 21 -	59.75
June 25 -	62.08

Date	Depth to water (feet)
Well 898 -- Continued	
1934 - July 23 -	63.19
Aug. 15 -	63.36
Sept.21 -	63.22
Oct. 22 -	62.62
Nov. 20 -	62.10
Dec. 20 -	59.76
1935 - Jan. 30 -	57.55
Feb. 28 -	56.58
Mar. 21 -	56.38
Apr. 23 -	55.92
May 20 -	55.51
June 18 -	55.63
July 25 -	
Aug. 16 -	
Sept.20 -	
	Obstructed

Well 900

Golf Crest Country Club, 5⅓ miles east-southeast of Houston post office. Depth, 360 feet (?). Measuring point, top of casing at level of ground.

1931 - Feb. 19 -	48.71 b/
Apr. 6 -	48.29 b/
July 13 -	41.28
Aug. 13 -	41.32
Sept. 8 -	41.37
Nov. 2 -	a/
Dec. 1 -	37.51
1932 - Jan. 8 -	36.88
Feb. 5 -	35.64
Mar. 3 -	33.82 ?
Apr. 7 -	36.22
May 6 -	36.13
June 6 -	36.40
July 8 -	36.75
Aug. 5 -	37.05
Sept. 6 -	36.82
Oct. 10 -	37.03 b/
Nov. 3 -	37.07
Nov. 23 -	37.00
Dec. 28 -	36.46
1933 - Jan. 27 -	35.98
Mar. 9 -	35.22
Apr. 14 -	35.48 b/
May 11 -	35.54
June 22 -	36.18

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 900 -- Continued	
1933 - Aug. 18	37.42 b/
Sept. 20	36.88 b/
Oct. 30	37.24
Nov. 21	37.27
Dec. 21	37.34
1934 - Jan. 22	37.91
Feb. 20	36.57
Mar. 20	36.49
Mar. 29	36.48
Apr. 19	36.37
May 21	36.63 b/
June 25	37.44
July 23	37.99 b/
Aug. 15	38.34
Sept. 21	38.89
Oct. 22	39.13
Nov. 20	39.16
Dec. 20	38.79
1935 - Jan. 30	38.43
Feb. 28	38.18
Mar. 21	38.05 b/
Apr. 23	38.11
May 20	38.17 b/
June 18	38.58
July 25	39.13
Aug. 16	39.43
Sept. 20	39.81
Oct. 25	39.71
Nov. 22	39.66
1936 - Feb. 19	38.67
Mar. 18	38.56
Apr. 24	38.79
May 8	38.90
May 21	38.80
June 22	39.25
July 23	39.74
Aug. 25	40.44
Sept. 25	40.87
Oct. 26	42.21
Nov. 24	41.33
Dec. 22	40.93
1937 - Jan. 27	40.49
Mar. 22	40.34
Apr. 26	40.53
May 19	40.92

Well 900A

Golf Crest Country Club, 5½ miles east-southeast of Houston post office. Depth, ?. Measuring point, top of casing.

Date	Depth to water (feet)
Well 900A -- Continued	
1936 - Oct. 26	57.00
Nov. 24	56.26
Dec. 22	53.22
1937 - Jan. 27	51.23
Mar. 22	51.50
Apr. 26	53.93
May 19	55.75

Well 908

J. W. Madden, 9 miles south-southeast of Houston post office near Hykawa. Depth, 900 feet +. Measuring point, top of casing, 0.7 foot above ground.

Date	Depth to water (feet)
1932 - June 6	23.30
July 8	23.32
Aug. 5	23.45
Sept. 6	23.34
Oct. 10	23.28
Nov. 3	24.76
Nov. 28	24.03
Dec. 28	23.57
1933 - Jan. 27	23.16
Mar. 9	22.93
Apr. 14	22.96
May 11	24.06
June 22	25.14
Oct. 30	25.91
Nov. 22	26.73
Dec. 21	27.22
1934 - Jan. 22	
Feb. 20	22.86
Mar. 20	21.08
Mar. 29	21.50
Apr. 19	21.56
May 21	
June 25	
July 23	22.49
Aug. 15	
Sept. 21	Inaccessible

Well 1105

A. A. Womack, La Porte, about 23 miles east-southeast of Houston post office. Measuring point, top of tee, 1.6 feet above level of ground. Abandoned well.

Date	Depth to water (feet)
1932 - Dec. 28	53.73
1933 - Jan. 27	53.15
Mar. 9	52.84
Apr. 14	52.67
May 12	53.48
June 22	54.50
Aug. 19	54.91
Sept. 20	54.72
Oct. 30	54.74
Nov. 22	54.43
Dec. 21	54.42
1934 - Jan. 22	53.64
Feb. 20	53.10
Mar. 20	52.93
Mar. 29	52.75
Apr. 19	52.54
May 21	52.95
June 25	54.07
July 23	54.58
Aug. 15	54.90
Sept. 21	55.37
Oct. 22	55.31
Nov. 20	54.56
Dec. 20	54.16
1935 - Jan. 30	54.40
Feb. 28	53.83
Mar. 21	53.67
Apr. 23	53.67
May 20	53.21
June 18	54.53
July 25	56.00
Aug. 18	57.10
Sept. 20	57.16
Oct. 25	57.19
Nov. 22	56.80
1936 - Feb. 19	56.05
Mar. 18	56.46
Apr. 24	59.93
May 8	56.97
May 21	57.18
June 22	58.28
July 24	58.20
Aug. 25	58.95

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 1105 -- Continued	
1936 - Sept. 25	59.46
Oct. 26	59.04
Nov. 24	58.57
Dec. 22	57.92
1937 - Jan. 27	57.54
Mar. 22	57.29
Apr. 26	57.48
May 19	57.45

Well 1170

Deepwater Plant of Houston Lighting & Power Co. 8½ miles east-southeast of Houston post office and about 1½ miles northwest of Pasadena. Depth, 836 feet. Measuring point, top of pump base, 2 feet above ground.

Date	Depth to water (feet)
1931 - Feb. 25	56.81
July 13	62.74
Aug. 13	64.74
Sept. 8	67.42
Nov. 2	65.30
Dec. 1	a/
1932 - Jan. 8	59.28
Feb. 5	54.71
Mar. 3	56.25
Apr. 7	58.91
May 6	a/
June 6	a/
July 8	a/
Aug. 5	a/
Sept. 6	a/
Oct. 10	62.46
Nov. 3	63.56
Nov. 3	63.10
Nov. 3	62.72
Nov. 3	62.48
Nov. 28	62.43
Dec. 28	63.80
1933 - Jan. 27	a/
Mar. 9	54.93
Apr. 14	a/
May 12	59.80
June 22	a/
Aug. 19	a/
Sept. 20	a/
Well 1170 -- Continued	
1933 - Oct. 30	67.10
Nov. 22	a/
Dec. 21	64.44
1934 - Jan. 22	a/
Feb. 20	63.20
Mar. 20	64.11
Mar. 29	a/
Apr. 19	a/
May 21	65.42
June 25	67.38
July 23	a/
Aug. 15	a/
Sept. 21	68.16
Oct. 22	65.27
Nov. 20	63.87
Dec. 20	a/
1935 - Jan. 30	60.62
Feb. 28	a/
Mar. 21	a/
Apr. 23	56.75
May 20	52.60
June 18	57.46
July 25	a/
Aug. 16	a/
Sept. 20	62.66
Oct. 25	56.67
Nov. 22	58.50
1936 - Feb. 19	57.73
Mar. 18	a/
Mar. 19	58.14
Apr. 24	53.47
May 8	57.69
May 21	57.65
June 22	a/
July 23	58.34
Aug. 26	a/
Sept. 25	60.83
Oct. 26	a/
Nov. 24	58.35
1937 - Mar. 22	80.52 ?
Apr. 26	Sealed
May 14	90.5
May 22	92.3
May 29	92.8
June 5	93.6

Well 1176

Texas Co. Refinery, Galena Park, 8½ miles east-southeast of Houston post office and about 2 miles north-northwest of Pasadena. Depth, 300 feet +. Measuring point, top of casing, 1.2 feet above ground. Abandoned well.

Date	Depth to water (feet)
1931 - Mar. 25	28.02
May 25	29.29
July 13	31.35
Aug. 13	31.05
Sept. 8	32.84
Nov. 2	34.80
Dec. 1	32.35
1932 - Jan. 8	31.92
Feb. 5	29.17
Mar. 3	28.82
Apr. 7	28.41
May 6	28.84
June 6	29.68
July 8	29.92
Aug. 5	31.95
Sept. 6	31.74
Oct. 11	31.21
Nov. 3	30.82
Nov. 28	31.28
Dec. 28	29.77
1933 - Jan. 27	29.70
Mar. 9	27.12
Apr. 15	27.46
May 12	28.15
June 22	31.78
Aug. 19	30.12
Sept. 20	32.78
Oct. 30	32.66
Nov. 22	33.25
Dec. 23	32.42
1934 - Jan. 23	32.33
Feb. 20	33.02
Mar. 20	33.24
Mar. 29	32.99
Apr. 19	33.13
May 21	33.43
June 25	34.75
July 23	36.29
Aug. 15	35.32
Sept. 21	34.37
Oct. 22	33.79
Nov. 20	33.06
Dec. 20	28.26

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Pasadena area -- Continued

Date	Depth to water (feet)
Well 1176 -- Continued	
1935 - Jan. 30	25.83
Feb. 28	25.26
Mar. 21	25.88
Apr. 23	
May 20	25.15
June 18	26.14
July 25	28.21
Aug. 16	27.25
Sept.20	28.37
Oct. 25	28.75
Nov. 22	28.30
1936 - Feb. 19	29.40
Mar. 18	27.38
Apr. 24	28.13
May 9	29.40
May 21	30.28
June 22	32.50
Aug. 25	33.12
	Obstructed
Oct. 26	31.23
Nov. 24	32.42
Dec. 22	31.14
1937 - Jan. 27	30.37
Mar. 26	51.31
Apr. 26	58.16
May 19	64.27

Well 1153

Kirby Lumber Co., Clinton, about 8 miles east-southeast of Houston post office and 2 miles northwest of Pasadena. Depth, 549 feet. Measuring point, top of casing, 4.5 feet above ground. Abandoned well.

1931 - Mar. 27	52.05 b/
May 27	46.89
July 13	49.16
Aug. 13	50.75
Sept. 8	48.50
Nov. 2	48.50
Dec. 1	54.18 b/
1932 - Jan. 8	47.30
Feb. 5	47.50
Mar. 3	46.30
Apr. 7	47.23
May 6	51.50 b/
June 6	53.88 b/
July 8	47.75
Aug. 5	48.53
Sept. 6	47.25
Oct. 11	51.65 b/
Nov. 3	48.22
Nov. 28	47.43
Dec. 28	46.86
1933 - Jan. 27	46.30
Mar. 9	46.18
Apr. 15	46.42
May 12	46.56
June 22	52.43 b/
Aug. 19	49.72 b/
Sept.20	49.84 b/
1936 - Apr. 9	48.40 ?
	Obstructed

Well 1153 -- Continued

Well 1186

American Service Co., Pasadena, 10 miles southeast of Houston post office. Depth, 220 feet. Measuring point, top of casing, 0.5 foot above ground. Abandoned well.

1932 - July 8	42.19
Aug. 5	42.67
Sept. 6	42.60
Oct. 10	43.02
Nov. 3	43.20
Nov. 28	43.43
Dec. 28	43.10
1933 - Jan. 27	42.95
Mar. 9	42.84
Apr. 14	42.71
May 12	43.05
June 22	43.42
Aug. 19	43.63
Sept.20	44.25
Oct. 30	44.44
Nov. 22	44.60
Dec. 21	44.49
1934 - Jan. 22	44.27
Feb. 20	44.12
Mar. 20	44.16
Mar. 29	44.11
Apr. 19	Filled in

Well 1196

Talford Jones, 13 miles southeast of Houston post office and 3 miles southeast of Pasadena. Depth, 550 feet +. Measuring point, top of casing, 1.3 feet above ground.

1932 - Dec. 28	62.05
1933 - Jan. 27	62.03
Apr. 14	61.92
May 12	62.56
June 22	62.30
Aug. 19	62.28
Sept.20	61.47
Oct. 30	61.22
Nov. 22	61.22
Dec. 21	61.22
1934 - Jan. 22	61.18
Feb. 20	61.12
Mar. 20	61.05
Mar. 29	61.00
Apr. 19	60.89
May 21	60.85
June 25	60.83
July 23	60.85
Aug. 15	
Sept.21	
1936 - Mar. 18	62.38
Apr. 24	62.65
May 8	62.74
May 21	62.83
June 22	63.03
July 24	63.29
Aug. 25	63.63
Sept.25	
Oct. 26	64.20
Nov. 24	64.44
Dec. 22	64.62
1937 - Jan. 27	64.82
Mar. 22	65.16
Apr. 26	65.31
May 19	65.37

a/ Pump running. b/ Pump running in nearby well.

Well 1203 (Harris County)

Harris County highway well, 11 miles southeast of Houston post office at South Houston. Depth, 600 feet +. Not used. Measuring point, top of casing, 0.5 foot above ground.

Date	Depth to water (feet)
1931 - Apr. 3	34.73
Sept.16	36.91
1932 - Oct. 7	38.25
Nov. 8	38.70
Nov. 26	38.97
Dec. 30	39.04
1933 - Feb. 1	39.15
Mar. 14	38.62
May 9	38.90
Oct. 26	39.85
1935 - Aug. 22	43.81
1936 - Feb. 28	39.36
Mar. 18	39.81
May 11	
Aug. 28	Obstructed

Well 1209 (Harris County)

Fireworks Co., 11 miles southeast of Houston post office and ½ mile southeast of South Houston. Depth, 650 feet +. Not used. Measuring point, top of air line, 4 feet above ground.

Date	Depth to water (feet)
1932 - Oct. 7	39.66
Nov. 8	39.95
Nov. 26	40.03
Dec. 30	39.75
1933 - Feb. 1	39.83
Mar. 14	39.41
May 9	39.83
Oct. 26	40.72
1935 - Aug. 22	43.77
1936 - May 11	42.97
Aug. 11	43.61
Aug. 23	45.03
Sept.17	45.32
Dec. 24	45.62
1937 - May 17	44.53

Well 1302 (Harris County)

City of Genoa, at Genoa. Depth, 832 feet. Measuring point, hole in 6-inch casing, 1 foot above ground.

Date	Depth to water (feet)
1931 - Apr. 3	48.06
Sept. 4	51.18
1932 - May 10	50.19
Oct. 7	52.12
Nov. 8	51.92
Nov. 26	51.92
Dec. 30	51.43
1933 - Feb. 1	51.19
Mar. 14	a/
May 9	a/
Oct. 26	52.18
1935 - Aug. 22	53.02
1936 - May 11	a/
May 12	53.91
Aug. 11	a/
Aug. 12	55.60
Dec. 24	Locked

Well 1360 (Harris County)

Mrs. Fain, ¼ mile east of Webster. Depth, 659 feet. Measuring point, top of casing, 2 feet above ground.

Date	Depth to water (feet)
1931 - Apr. 3	31.47
Aug. 7	37.29
Sept. 4	36.00
1932 - May 10	32.25
July 9	37.26
Oct. 7	a/
Nov. 8	35.96
Nov. 26	35.36
Dec. 30	34.45
1933 - Feb. 1	33.76
Mar. 14	33.43
May 9	34.30
1935 - Aug. 22	
1936 - Feb. 28	38.70
May 12	40.15 a/
Aug. 11	Obstructed
Aug. 29	"
Sept.17	"
Dec. 31	42.45
1937 - May 17	45.18

Well 26 (Galveston County)

Galveston, Houston and Henderson Railway, at League City. Depth, 1,020 feet. Measuring point, top of casing, 3 feet above ground. Abandoned well.

Date	Depth to water (feet)
1931 - Apr. 15	14.86
Sept. 4	17.53
1932 - May 10	15.82
Sept.20	17.19
Oct. 7	16.98
Nov. 8	17.22
Nov. 26	17.43
Dec. 30	18.71
1933 - Feb. 1	16.30
Mar. 14	15.85
May 9	16.18
Oct. 26	16.73
1935 - Aug. 23	15.80
1936 - Feb. 28	14.45
May 12	14.92
Aug. 11	16.04
Aug. 29	16.19
Sept.17	16.21
Dec. 30	18.07
1937 - Jan. 28	15.75
May 17	16.37

Well 112 (Galveston County)

Galveston, Houston and Henderson Railway, 6½ miles northeast of Alta Loma. Depth, 750 feet. Measuring point, top of casing, 1 foot above ground.

Date	Depth to water (feet)
1931 - Apr. 15	18.89
Sept.16	23.12
1932 - Oct. 7	24.10
Nov. 8	24.37
Nov. 26	23.33
Dec. 30	21.41
1933 - Feb. 1	20.82
Mar. 14	20.57
May 9	22.86
Oct. 26	25.10
1935 - Aug. 23	35.68
1936 - Feb. 28	37.48

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations, Houston-Galveston area -- Continued

Date	Depth to water (feet)
Well 112 -- Continued	
1936 - May 12	40.20
Aug. 11	42.80
Aug. 28	43.00
Sept.17	43.68
1937 - Jan. 2	40.15
Jan. 28	39.33
May 17	46.93

Well 113 (Galveston County)

E. Menotti, 7 miles northeast of Alta Loma. Depth, 504 feet. Measuring point, top of pipe clamp, 6 inches above ground.

1932 - Sept.20	14.92
Oct. 7	14.98
Nov. 8	15.17
Nov. 26	15.20
Dec. 30	15.40
1933 - Feb. 1	14.94
Mar. 14	14.86
Apr. 9	16.12
Oct. 26	15.70
1935 - Aug. 23	18.25
1936 - Feb. 28	19.45
May 11	19.04
Aug. 11	21.73
Aug. 29	20.63
Sept.17	20.62
1937 - Jan. 28	21.47
May 17	a/

Well 115 (Galveston County)

J. W. Palmer, 6 miles northeast of Alta Loma. Depth, 526 feet. Measuring point, top of air line, 4¼ feet above ground.

1932 - Sept.20	19.38
Oct. 7	19.36
Nov. 8	19.56
Nov. 26	19.55
Dec. 30	19.16
1933 - Feb. 1	18.93
Mar. 14	18.80
May 9	19.15
Oct. 26	20.14
1935 - Aug. 23	23.95
1936 - Feb. 28	27.25
May 11	27.84
Aug. 11	31.66
Aug. 29	24.69
Sept.17	32.78
1937 - Jan. 2	31.49
Jan. 28	29.95
May 17	43.91

Well 206 (Galveston County)

A. J. Biran, 3½ miles west of Texas City. Depth, 926 feet. Measuring point, hole under 1-inch pipe, 11 inches above top of casing.

1931 - Apr. 15	7.23
1932 - Oct. 7	9.64
Nov. 8	9.13
Nov. 26	8.96
Dec. 30	9.13
1933 - Feb. 1	9.28
Mar. 14	9.07
May 9	9.43
Oct. 26	12.10
1935 - Aug. 23	30.30
1936 - Feb. 28	30.00
May 11	35.54
Aug. 11	Obstructed
1937 - Jan. 2	34.05
Jan. 28	33.90
May 24	40.42

Well 272 (Galveston County)

City of Galveston, at Alta Loma. Depth, 808 feet. No pump. Measuring point, top of 12-inch receiver, 7 feet above ground.

1932 - Sept.23	38.84
Oct. 7	38.20
Nov. 8	37.12
Nov. 26	32.63
Dec. 30	37.61
1933 - Feb. 1	34.13
Mar. 14	34.10
May 9	39.67
Oct. 26	40.52
1935 - Aug. 23	53.50
1936 - Feb. 28	37.52
May 12	48.92
Aug. 11	46.67
Sept.17	51.28
1937 - Jan. 2	40.26
May 24	52.70

Well 297 (Galveston County)

Chas. Schiro, 4 miles southeast of Alta Loma. Depth, 720 feet. Gas engine pump. Measuring point, top of casing, 6 inches above ground.

1932 - Sept.22	12.52
Oct. 7	11.71
Nov. 8	11.68
Nov. 26	11.48
Dec. 30	10.71
1933 - Feb. 1	10.66
Mar. 14	10.50
May 9	11.10
Oct. 26	11.82
1935 - Aug. 23	19.96
1936 - Feb. 28	19.10
May 12	19.50
Aug. 12	24.67
Sept.17	21.96
1937 - Jan. 2	25.47
May 24	30.33

a/ Pump running. b/ Pump running in nearby well.

Water level fluctuations in observation wells in areas north and northwest of Houston

Date	Depth to water (feet)
Well 205	
Humble Pipe Line Co., 6¼ miles southeast of Cypress; drilled. Depth, 700 feet. Air and oil pump. Measuring point, top of casing, 1 foot above ground.	
1931 - Apr. 7 -	23.91
May 19 -	23.34
June 19 -	24.13
July 23 -	24.17
Sept.24 -	26.22
Dec. 12 -	25.62
1932 - Jan. 13 -	25.30
Feb. 10 -	25.11
Mar. 16 -	24.70
May 25 -	24.56
June 24 -	25.29
Aug. 28 -	27.00
Nov. 28 -	27.30
Dec. 28 -	26.77
1933 - Mar. 11 -	26.02
1934 - Apr. 25 -	26.46
1935 - Aug. 20 -	27.17
1936 - Feb. 25 -	26.78
May 13 -	26.16
Aug. 17 -	21.46
Sept.10 -	27.87
1937 - Jan. 12 -	b/
May 18 -	b/
Well 206	
R. B. Tucker, 6½ miles southeast of Cypress; drilled. Depth, 450 feet +. Air and gas pump. Measuring point, top of board cover by suction pipe.	
1931 - Apr. 2 -	22.50
June 19 -	23.59
July 23 -	25.18
1931 - Sept.24 -	27.30
Dec. 12 -	26.51
1932 - Jan. 13 -	25.78
Mar. 16 -	23.67
Apr. 19 -	23.55
May 25 -	23.90
June 24 -	25.32
July 22 -	26.62
Sept.29 -	27.67
Oct. 28 -	27.94
1933 - Mar. 11 -	26.82
June 26 -	27.08
Nov. 20 -	28.38
1934 - Nov. 28 -	28.05
1935 - May 30 -	25.52
Aug. 20 -	27.84
1936 - Feb. 25 -	27.92
May 13 -	23.43
Aug. 17 -	26.86
Sept.10 -	26.93
1937 - Jan. 12 -	25.78
May 18 -	23.45
Well 256	
J. H. Blake, Houston-Conroe road, 14 miles north of Houston post office. Depth, 189 feet. Measuring point, plug in top of casing.	
1931 - Nov. 9 -	28.86
Dec. 9 -	28.80
1932 - Jan. 12 -	28.54
Feb. 9 -	28.24
Mar. 7 -	27.60
Apr. 11 -	27.28
May 7 -	27.28
July 1 -	27.53
Aug. 31 -	28.20
Oct. 2 -	28.92
Nov. 26 -	29.36
Dec. 30 -	29.30
1933 - Jan. 25 -	29.42
1933 - May 8 -	28.43
June 6 -	28.40
1934 - Apr. 26 -	28.75
Nov. 29 -	30.49
1935 - May 29 -	28.75
Aug. 22 -	29.00
1936 - Feb. 27 -	28.20
June 3 -	27.59
1937 - Jan. 29 -	28.91
May 18 -	28.26
Well 264	
Weary farm, 15 miles north of Houston post office. Depth, 1,610 feet. Water from 950 foot sand. Measuring point, top of casing. Abandoned well.	
1931 - May 29 -	3.00
Nov. 18 -	5.08
1932 - Jan. 19 -	5.36
Mar. 21 -	5.66
May 21 -	6.44
July 25 -	7.46
Sept.27 -	8.30
Oct. 21 -	8.36
Nov. 26 -	8.69
Dec. 30 -	8.66
1933 - Jan. 25 -	8.92
Mar. 15 -	8.96
May 8 -	9.66
June 24 -	10.10
1935 - Aug. 22 -	21.30
1936 - Feb. 26 -	21.37
Mar. 30 -	21.22
June 3 -	20.95
Sept.11 -	20.95
1937 - Jan. 11 -	22.43
May 18 -	23.52

a/ Pump running. b/ Pump running in nearby well.

TABLE 2

Analyses of water from wells in Houston, Texas

(Analyzed in laboratory of U. S. Geological Survey by Margaret D. Foster and others, unless otherwise specified.)

(Parts per million.)

Well No.	Owner	Date of collection	Depth (feet)	Total dissolved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
a/589	City of Houston	Sept. 12, 1931	2,090	451	d/.2	25	9.1	144	330	9	82	--	100
b/600	do.	Oct. 7, 1929	558	400	d/14	63	14	64	293	24	65	--	215
620	Public Laundries	Mar. 30, 1935	1,379	328	.03	8.2	2.3	127	297	2.0	42	.64	30
688-690	City of Houston	May 9, 1932	-	362	.17	22	5.8	109.9	301	7.8	48	.0	79
b/710	Niels-Esperson Bldg.	Mar. 9, 1927	883	305	--	29	11	75	260	21	31	--	118
732	Gould Wet Wash Laundry	do.	1,392	415	--	7.2	11	148	373	8.6	50	--	63
740	Houston Electric Co.	July 21, 1933	537	258	.56	32	10	58	234	13	30	.0	121
744	City of Houston	May 9, 1932	1,860	---	--	--	--	--	380	1	91	.0	18
a/793	do.	Sept. 12, 1931	2,150	342	d/1.2	15	4.8	112	268	11	49	--	57
808	Gem Electric Co.	July 21, 1933	340	310	.14	62	14	41	270	12	48	.0	212
811	Harris County	do.	385	298	.09	71	12	29	254	9.2	51	.40	227
a/878	Houston Compress Co.	Nov. 9, 1929	905	267	d/4.2	23	6.4	69	220	14	28	--	83
879	City of Houston	May 9, 1932	1,037	286	0.16	34	7.5	61.1	239	16	26	0.20	116
a/892	Lone Star Cement Co.	Feb. 4, 1929	1,284	425	d/1.4	8.4	2.4	159	354	12	53	--	31
1,160	Allendale Subdivsion	Aug. 1, 1933	160	---	2.9	--	--	--	358	8	445	.96	454
c/1,168	Houston Lighting and Power Company	Mar. 1, 1922	979	281	d/1.4	18	6.7	83	229	14	35	.3	72
c/1,169	do.	do.	1,100	302	d/4.8	9.3	5.1	103	227	12	41	.5	44

a/ Analysis by Houston Laboratories.

b/ Analysis by Curtis Laboratories.

c/ Analysis by Penn Power and Light Company.

d/ Iron and aluminum oxides.

Analyses of water from wells in Harris County, Texas.. (Outside Houston.)
(Analyzed in laboratory of U. S. Geological Survey by Margaret D. Foster and others, unless otherwise specified.)
(Parts per million.)

Well No.	Owner	Date of collection	Depth (feet)	Total dissolved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na. + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
93	Missouri Pacific Ry.Co.	Mar.31,1936	1,070	344	.05	16	5.9	119	325	11	32	.05	64
136	J. Freeman	Aug. 7, 1933	138	252	.35	61	5.4	32	237	4.0	33	.0	175
169	Houston and Texas Central R.R.	Sept.28,1929	400	203	--	25	3.4	41	124	4.4	42	--	76
225	Trinity and Brazos Valley R.R.	Oct.27, 1931	616	332	--	65	5.7	41	189	12	75	--	186
b/281a	Humble City	Dec.31,1936	1,140	601	3	7.3	1.5	168	322	1.5	88		23
b/281b	do.	Dec.21,1936	--	595	3	7.5	1.3	166	319	1.3	88		25
b/321a	Black Cat Oil Test	do.	--	377	2	23	1.7	83	204	3.6	52		64
b/326	Gulf Pipe Line Co.	do.	533	472	3	9.1	2.1	106	251	5.8	36		31
370	J. M. Johnson	Aug. 2,1932	625	347	.10	68	7.3		254	11	47	.10	200
399	Gertie Rice Farm	Aug. 1, 1932	326	335	.03	69	7.0	35	260	4	42	.20	201
431	G. E. Wilkins	June 2,1936	800?	423	---	9.6	5.2	161	378	3	58	.0	45
492	Galveston, Houston & San Antonio Ry.	May 5, 1931	220	484	d/1.6	77	21	81	341	16	113	Trace	279
809	Gem Electric Co.	May 17,1936	1,100±	314	---	8.4	4.8	116	266	1	52	.65	41
828	Rio Brave Oil Co.	Aug.12,1933	248	---	.15	--	--	124	276	11	32	.2	183
829	C. S. Settegast	do.	350	---	-	--	--		272	14	31	1.1	183
906	Gardenvilla Subdivision	June 7,1929	875	316	d/2.6	26	6.6	88	256	16	38	--	88
1,103	Galveston, Harrisburg and San Antonio Ry.	Oct.6,1931	770	726	d/4.6	5.7	2.6	289	570	--	133	.9	25
1,151	Southern Pacific Ry.	Sept.19,1930	793	301	--	24	4.1	79	228	16	31	.50	77
1,162a	Sinclair Refining Co.	June 5,1936	1,300	399	--	4.4	2.6	162	390	1	37	.0	22
1,172	Texas Company	June 6, 1936	1,376	311	--	14	4.7	109	288	8	33	.0	54
1,201	Shell Petroleum Co.	June 5, 1936	860	564	--	5.0	2.5	230	510	1	74	.0	23
1,251	C. F. Smith	May 30, 1936	728	145	--	26	7.9	21	146	4	13	.75	97
1,302	City of Genoa	Mar.30,1935	832	461	.12	11	3.7	177	388	3.1	75	.12	43
1,329	J. W. Goar	July 20,1933	473	429	1.9	16	8.5	151	378	1.2	66	.12	75
1,329	do.	Mar.29,1935	473	522	1,5	24	15	169	392	4.1	115	1.7	122
1,364	Humble Pipe Line Co.	Aug. 1, 1933	81	--	.65	--	--	[illegible]	458	60	645	.60	352

b/ Analysis by A. J. Hartsook, Rice Institute.
d/ Iron and aluminum oxides.

Analyses of water from wells in Harris County--Continued
(Parts per million.)

Well No.	Owner	Date of collection	Depth (feet)	Total dissolved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
1,365	Humble Pipe Line Co.	July 18,1933	652	465	.07	11	3.0	--	324	1.3	94	.10	40
1,366	Galveston-Houston Elec. Co.	1934	---	1,175	d/5.0	44	45	333	110	96	588	—	294

a/ Analysis by Houston Laboratories.
b/ Analysis by A. J. Hartsook, Rice Institute.
d/ Iron and aluminum oxides.

Analyses of water from wells in Waller County, Texas
(Analyzed in laboratory of U. S. Geological Survey by Margaret D. Foster and others, unless otherwise specified.)
(Parts per million.)

Well No.	Owner	Date of collection	Depth (feet)	Total dissolved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
c/108a	Texas Louisiana Power Company	Jan. 2,1930	518	517	d/15	40	11	138	390	6.7	85	--	145
108b	do.	Jan. 6,1930	723	451	d/20	50	7.5	115	372	10	66	--	156
119	Prairie View State College	-- 1930	576	309	--	34	11	70	255	23	36	--	130
120	do.	Mar.24,1928	574	415	--	36	5.5	111	336	30	34	--	113
230	Francis Young	Aug. 1,1932	237	240	.02	63	5.9	24	220	2	37	.15	182

c/ Analysis by Curtis Laboratories.
d/ Iron and aluminum oxides.

Analyses of water from wells in Galveston County, Texas
(Analyzed in laboratory of U. S. Geological Survey by Margaret D. Foster and others, unless otherwise specified.)
(Parts per million.)

Well No.	Owner	Date of collection	Depth (feet)	Total dissloved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
23	Joe L. Taylor	Oct.22,1927	800	---	—	12	2.0	---	268	—	72	—	38
23	do.	July 19,1933	800	586	9.2	51	33	141	520	7.2	97	.10	203
62	W. R. McClendon	May 10,1932	170	1,048	.96	30	20	Na 354 K 8.2	602	60	271	3.7	157
101	H. E. Carter	May 26,1928	200	913	d/3.0	33	15	318	806	2.7	123	—	144
108	Dickinson Ice Co.	Mar.29,1935	576	447	.04	5.0	1.5	181	370	1.7	75	.64	19
111a	Fig Plant	July 18,1926	875	1,920	d/3.2	15	7.0	736	334	1.7	985	—	66
111b	do.	July 16,1933	215	832	.34	20	12	Na 292 K 3.8	600	.8	175	.30	99
184	Southern Pacific Ry.	Sept.17,1931	600	703	d/3.9	8.9	2.1	---	443	—	182	1.2	31
223	Otis Walker	July 18,1933	246	366	.36	14	11	332	688	3.3	166	.61	80
a/224	Texas-Louisiana Power Company	Jan.13,1916	1,038	1,496	—	20	11	---	261	—	767	—	95
a/226	do.	May 9, 1910	812	682	—	7.8	2.5	261	379	6.5	198	—	30
227	do.	July 18,1933	763	822	.20	8.5	3.0	Na 311 K 3.9	478	1.1	230	.20	34
230	Pan American Refining Corp.	July 19,1933	611	811	.82	7.7	3.1	Na 305 K 3.8	578	1.6	162	.12	32
239	Texas City Terminal Railway	do.	855	990	1.0	9.2	3.4	Na 371 K 3.5	511	.8	305	.20	37
264	City of Galveston	July 22,1933	843	852	.13	20	6.6	Na 302 K 3.8	331	1.2	330	.10	77
264	do.	Mar.29,1935	843	979	.15	26	8.0	356	333	2.6	422	.38	98
279	M. J. Mouna	July 22,1933	120	765	1.9	42	30	229	626	12	140	3.8	228
289	R. G. Roberts	do.	260	1,095	2.9	23	18	398	598	4.5	355	.20	131
291	Hitchcock Ice & Fuel Company	do.	720	577	0.47	8.7	3.5	Na 213 K 2.2	399	1.3	124	0.05	36
293	L. Schansa	Oct. 10,1930	208	---	d/.7	22	5.8	---	304	—	302	—	79

a/ Analysis by Houston Laboratories.
d/ Iron and aluminum oxides.

Analyses of water from wells in Galveston County--Continued
(Parts per million.)

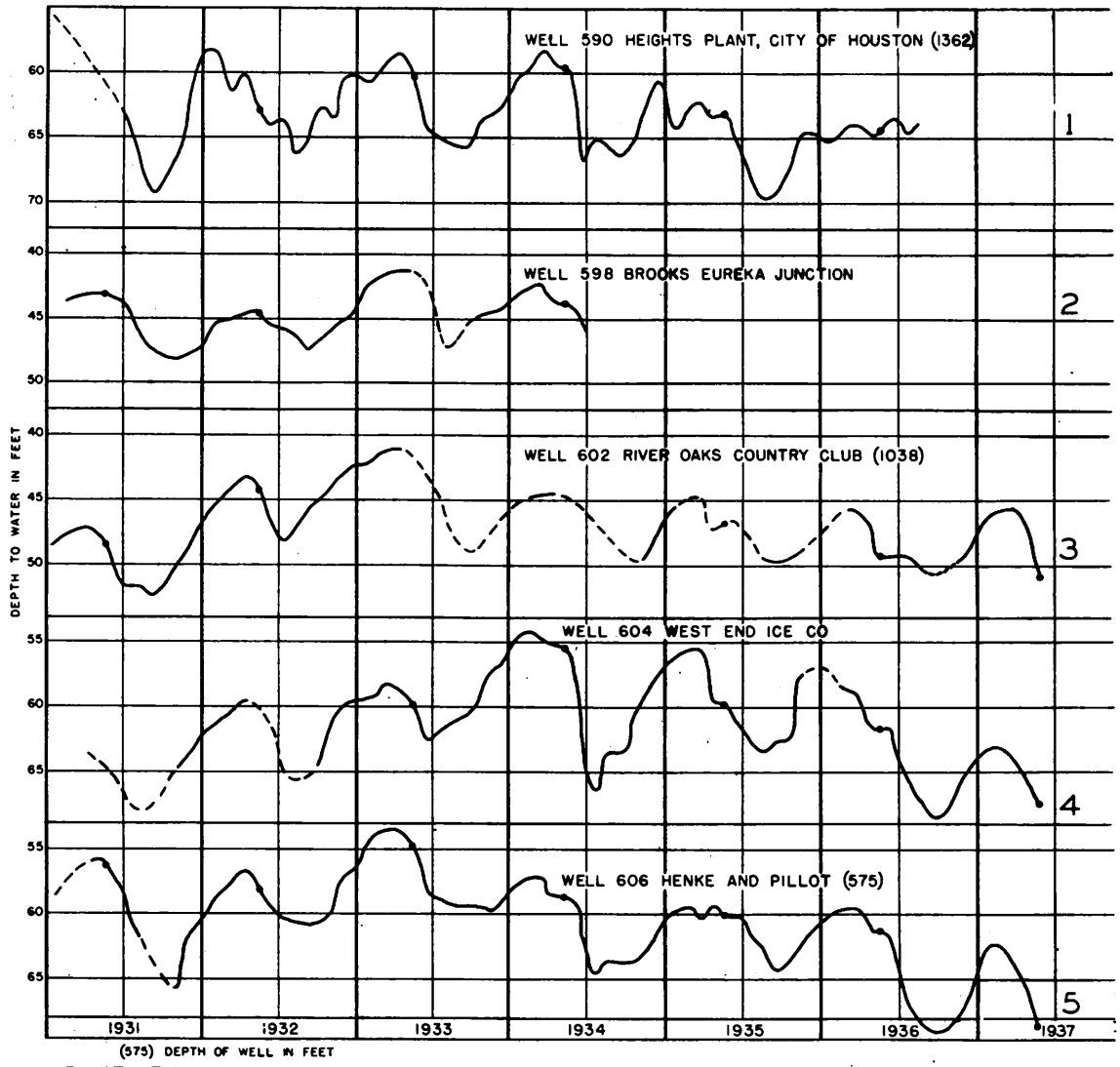
Well No.	Owner	Date of collection	Depth (feet)	Total dissolved solids	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (Calc.)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_2)	Total hardness as $CaCO_3$ (Calc.)
351	- Derringer	July 22,1933	533	569	3.3	7.1	2.8	226	431	1.5	118	.05	29
355	P. H. Naschke	July 19,1933	710	690	1.5	6.8	2.6	269	447	1.2	189	.15	28
356	R. L. Whitburn	July 18,1933	117	846	.89	49	18	274	664	2.2	171	4.5	196
360	Sinclair Refinery No. 3	July 19,1933	1,030	1,875	.38	28	12	Na 680 K 6.0	350	1.2	940	.50	119
412	Galveston Ice & Cold Storage Company	May 10, 1932	1,345	5,840	2.2	90	54	Na 2,096 K 23	331	.6	3,381	.0	446
a/416	Gulf Colorado and Santa Fe R.R.	Jan. 1, 1932	1,088	1,800	d/4.8	16	6.3	676	446	.9	830	--	66
417	Geo. Sealy	July 2, 1927	1,000	1,705	—	54	31	588	726	25	648	--	262

a/ Analysis by Houston Laboratories.
d/ Iron and aluminum oxides.

Analyses of water from wells in Fort Bend County, Texas

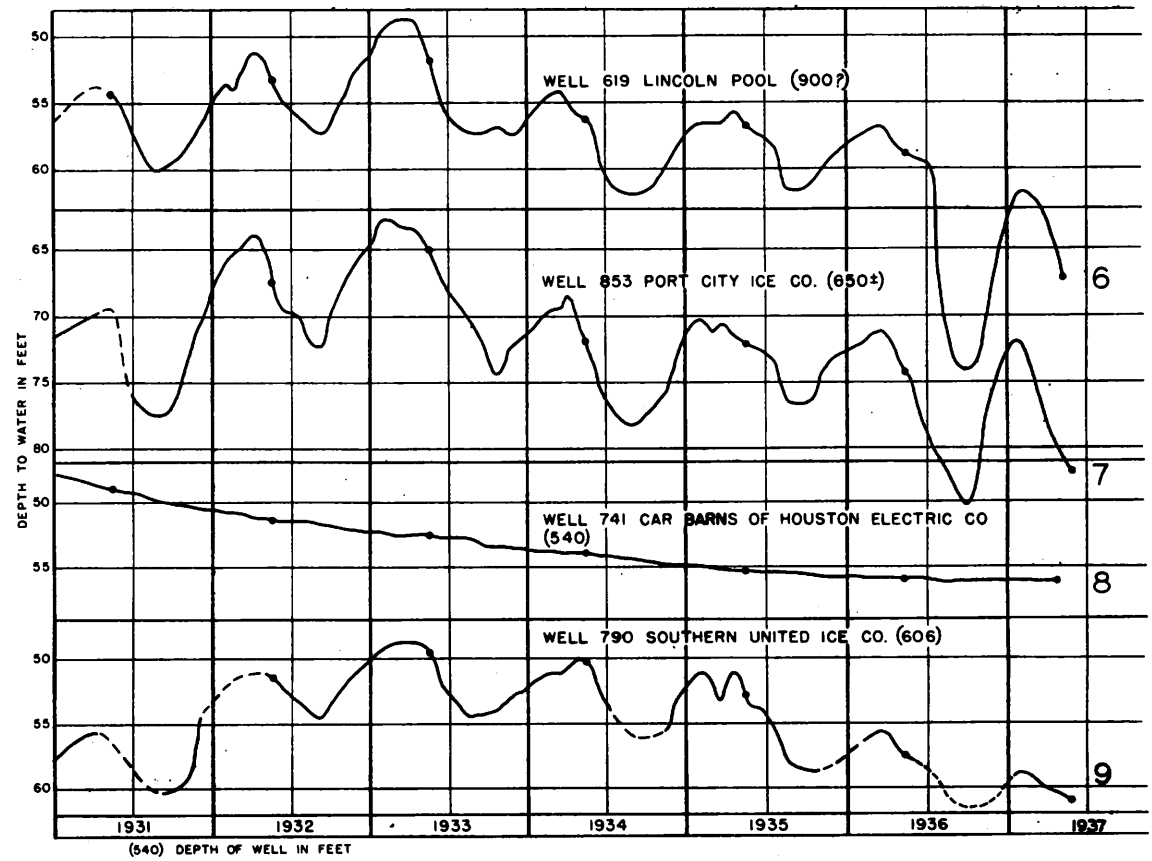
2	S. A. & A. P. R.R.	May 14,1931	900	--	d/2.6	47	4.9	--	222	--	38	0.23	138
23	G. Phillips	Aug. 7,1933	70	--	—	--	—	--	360	11	242	6.0	402
27	Southern Pacific Ry.	May 14,1931	200	--	d/3.4	77	6.5	--	294	--	50	.23	219
53a	Sugarland Ind.	June 2,1936	733	--	—	--	--	--	232	12	61	--	237
54	do.	do.	1,606	337	—	14	5.9	115	257	18	57	.25	59
70	State of Texas	Aug.16,1933	240	340	.02	56	17	55	279	13	62	.0	210
71	Sinclair-Prairie Oil Company	Aug. 15,1933	285	328	.08	44	11	72	277	15	49	.10	155
74	State of Texas	do.	304	775	.04	9.3	2.9	302	376	17	257	.53	35
91a	House Estate	June 8,1936	350?	313	--	14	--	74	378	1	37	.0	145

d/ Iron and aluminum oxides.



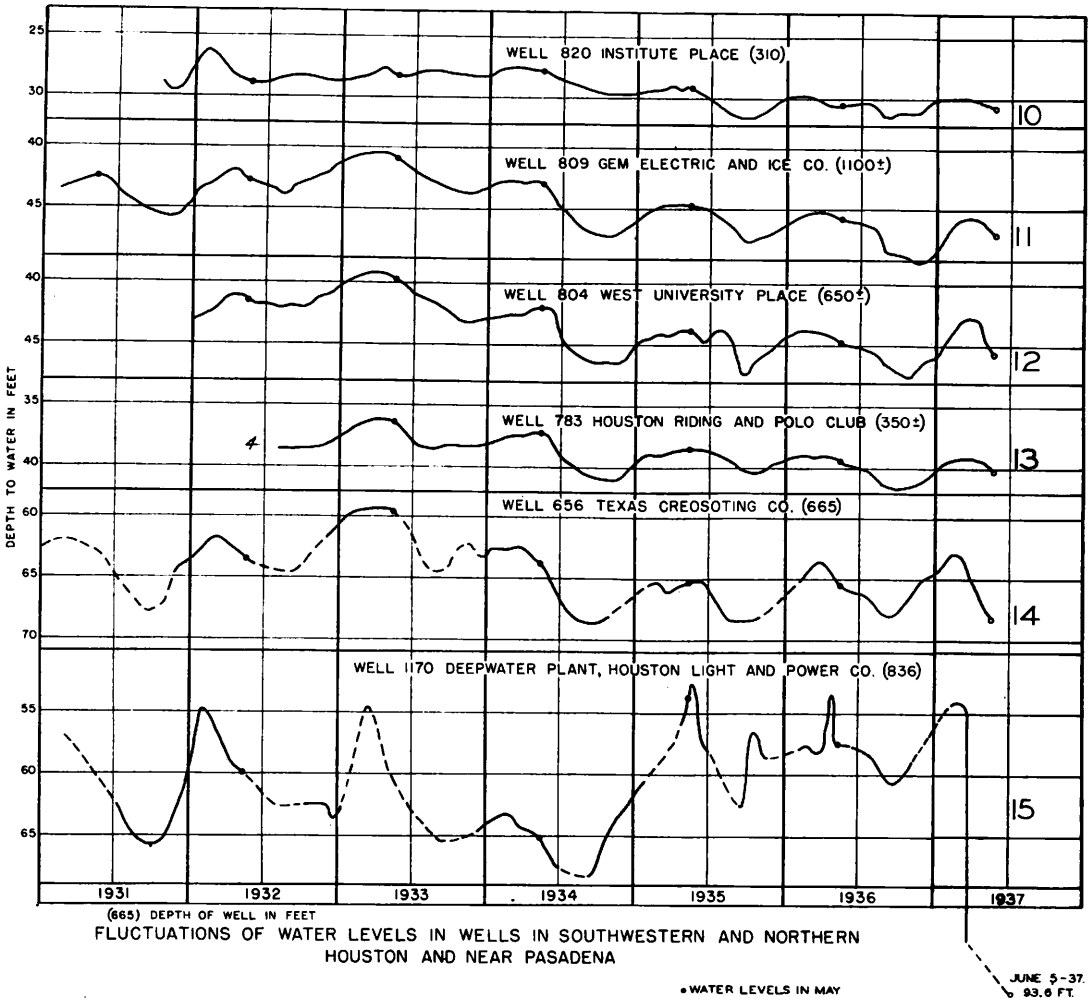
FLUCTUATIONS OF WATER LEVELS IN WELLS IN WESTERN AND NORTHWESTERN HOUSTON

• WATER LEVELS IN MAY



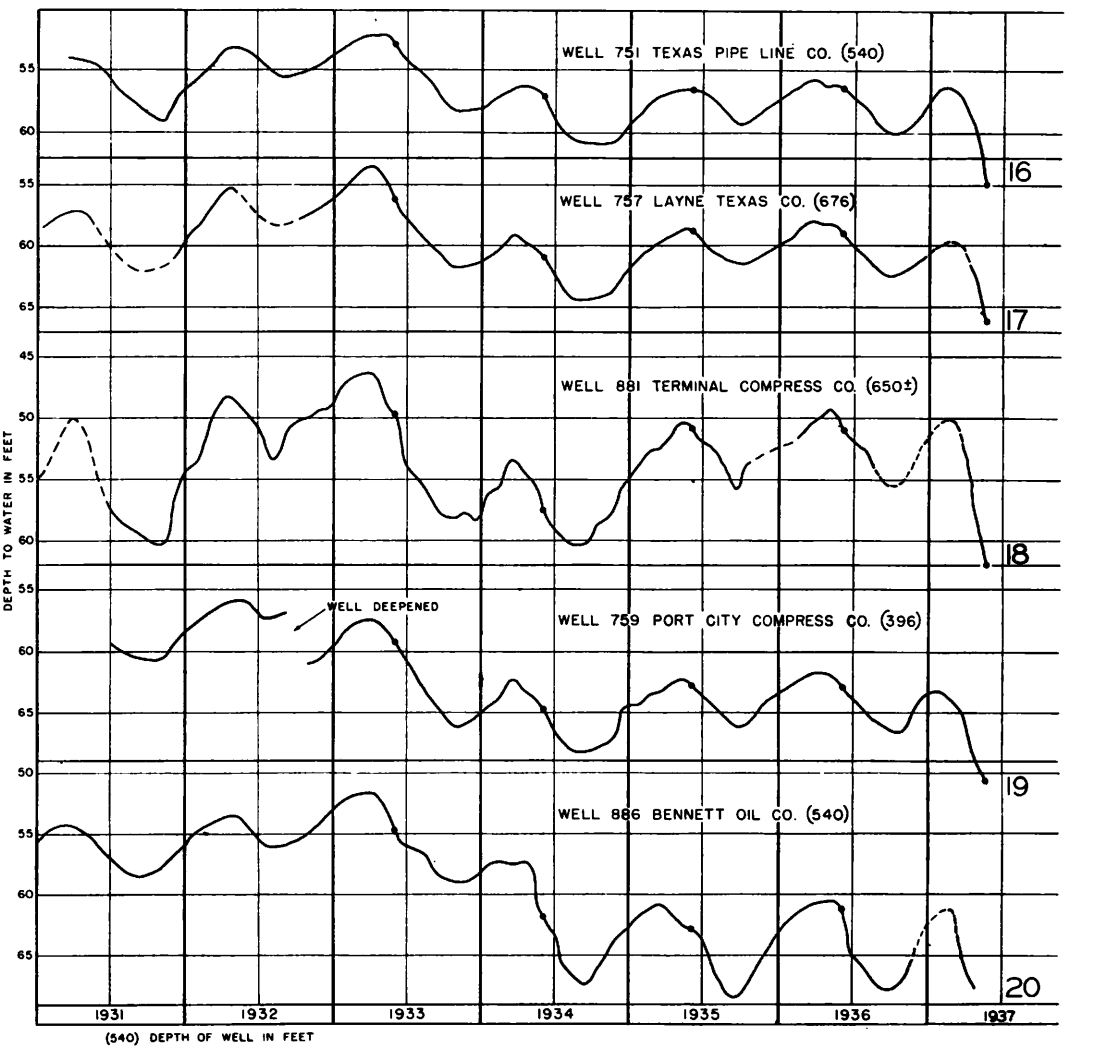
FLUCTUATIONS OF WATER LEVELS IN WELLS IN CENTRAL HOUSTON

• WATER LEVELS IN MAY



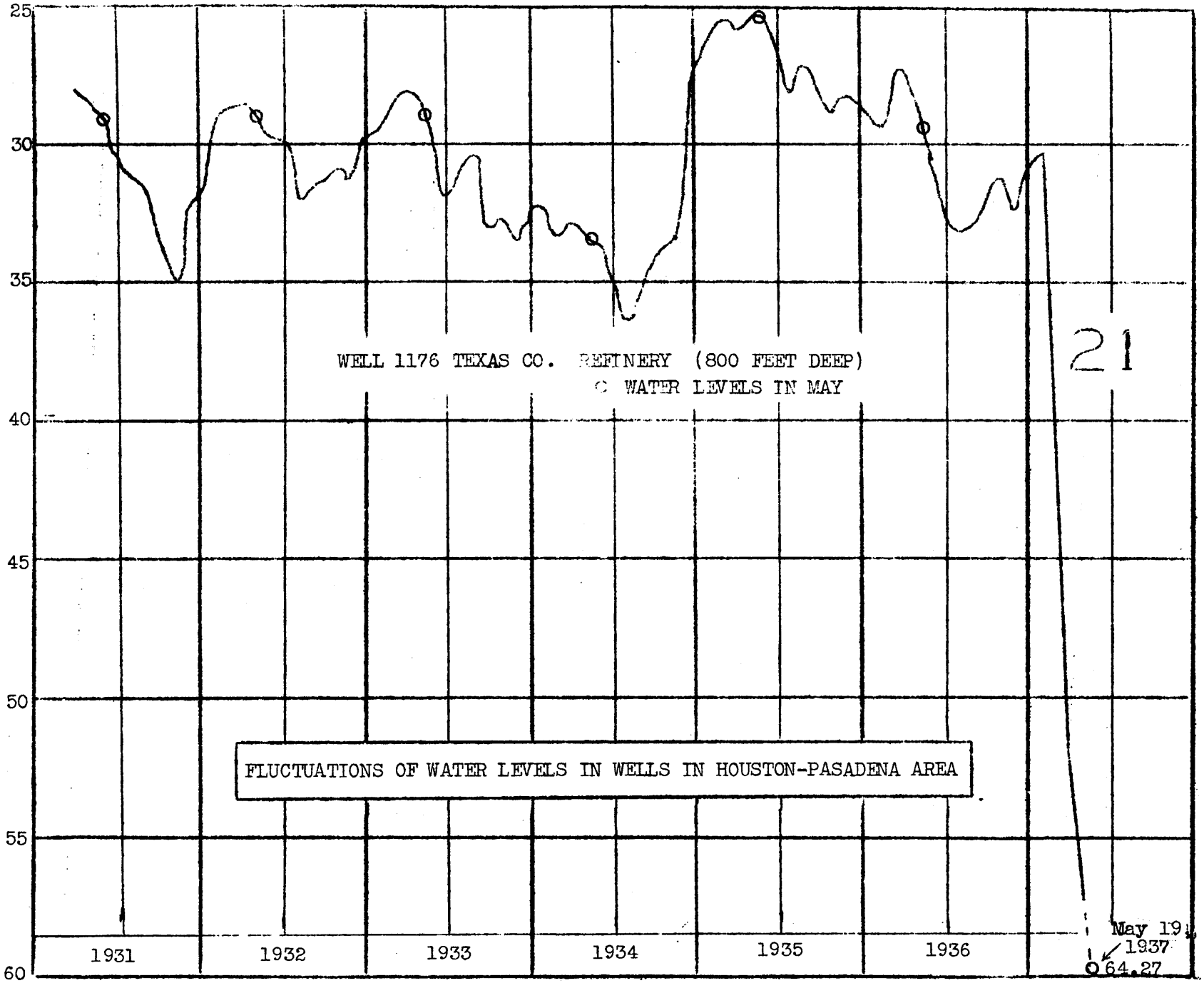
FLUCTUATIONS OF WATER LEVELS IN WELLS IN SOUTHWESTERN AND NORTHERN HOUSTON AND NEAR PASADENA

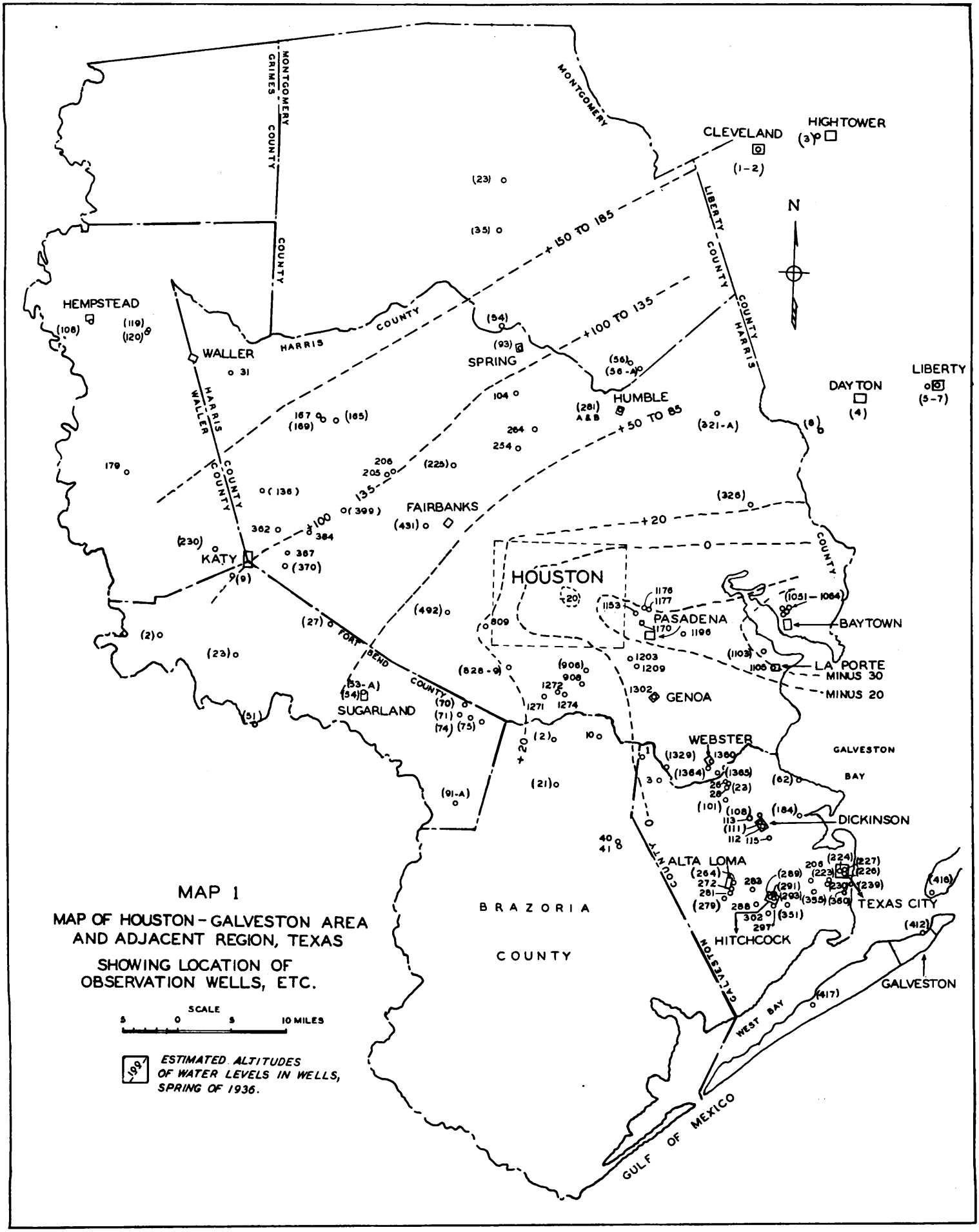
• WATER LEVELS IN MAY



FLUCTUATIONS OF WATER LEVELS IN WELLS IN EASTERN AND SOUTHEASTERN HOUSTON

• WATER LEVEL IN MAY


25
30
35
40
45
50
55
60
WELL 1176 TEXAS CO. REFINERY (800 FEET DEEP)
WATER LEVELS IN MAY
21
FLUCTUATIONS OF WATER LEVELS IN WELLS IN HOUSTON-PASADENA AREA
1931
1932
1933
1934
1935
1936
May 19
1937
64.27



MAP 1

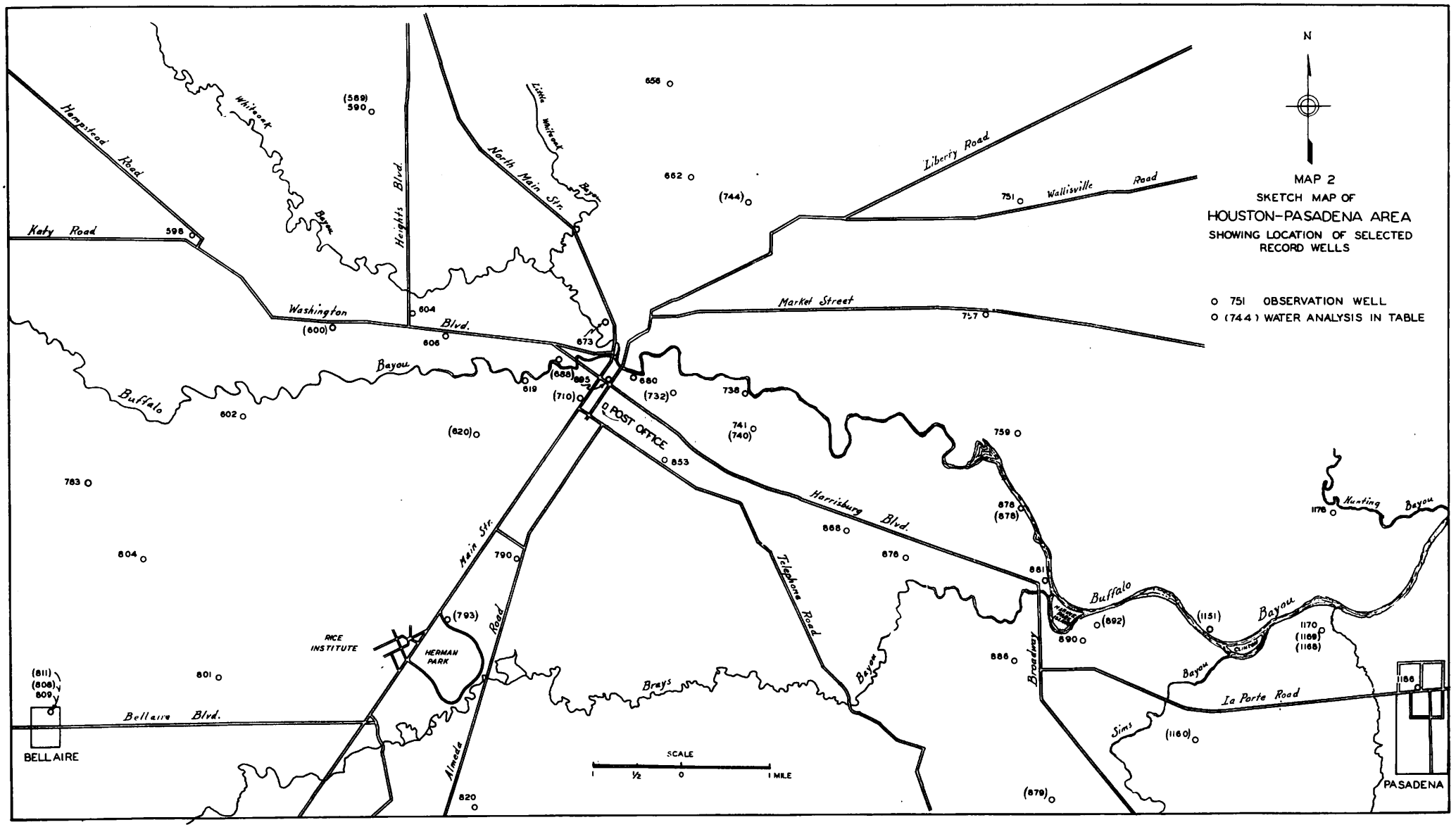
MAP OF HOUSTON - GALVESTON AREA AND ADJACENT REGION, TEXAS

SHOWING LOCATION OF OBSERVATION WELLS, ETC.

SCALE

5 0 5 10 MILES

(109) *ESTIMATED ALTITUDES OF WATER LEVELS IN WELLS, SPRING OF 1936.*


N
MAP 2
SKETCH MAP OF
HOUSTON-PASADENA AREA
SHOWING LOCATION OF SELECTED RECORD WELLS
o 751 OBSERVATION WELL
o (744) WATER ANALYSIS IN TABLE
Hempstead Road
Katy Road
Washington Blvd.
Heights Blvd.
Whiteoak Bayou
Little Whiteoak Bayou
North Main Str.
Liberty Road
Wallisville Road
Market Street
Buffalo Bayou
Harrisburg Blvd.
POST OFFICE
Main Str.
Telephone Road
Almeda Road
Broadway
Hunting Bayou
Ia Porte Road
Brays Bayou
Sims Bayou
Bellaire Blvd.
RICE INSTITUTE
HERMAN PARK
BELLAIRE
PASADENA
SCALE
1 ½ 0 1 MILE