WATER SUPPLY REPORT NUMBER TWO

STATE OF MICHIGAN
DEPARTMENT OF CONSERVATION
GERALD E. EDDY, DIRECTOR
GEOLOGICAL SURVEY DIVISION
WILLIAM L. DAOUST, STATE GEOLOGIST

SUMMARY OF GROUND-WATER CONDITIONS IN MICHIGAN 1957

BY
P. R. GIROUX
U. S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE UNITED STATES
DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

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INTRODUCTION

This report is the second of a series covering ground-water levels and related hydrologic data in the State of Michigan. It summarizes and interprets, in part, the results of the program of measurement of ground-water levels and the collection of other pertinent information by the United States Geological Survey. This program is a part of the overall water resources investigations carried out in cooperation with the Geological Survey Division of the Michigan Department of Conservation.

Cooperative ground-water investigations by the U. S. Geological Survey in Michigan are directed jointly by A. N. Sayre, Chief of the Ground Water Branch, U. S. Geological Survey, Washington, D. C., and W. L. Daoust, State Geologist, Michigan Department of Conservation, Lansing, and are supervised by Morris Deutsch, District Geologist, U. S. Geological Survey, Lansing.

Records and interpretations of water levels and artesian pressures from 1935 through 1955 have been published in the annual series of U. S. Geological Survey Water-Supply Papers entitled "Water levels and artesian pressures in the United States." The following tabulation gives the numbers of those papers containing water-level data for Michigan:

Year	No.	Year	No.	Year	No.
1935	777	1942	944	1949	1156
1936	817	1943	986	1950	1165
1937	840	1944	1016	1951	1191
1938	845	1945	1023	1952	1221
1939	886	1946	1071	1953	1265
1940	906	1947	1096	1954	1321
1941	936	1948	1126	1955	1404

Beginning in 1956, the U. S. Geological Survey discontinued publication of its series of annual reports and is now publishing, at five-year intervals, a reduced number of water-level records without interpretive text or illustrations.

The needs of the State, however, require more detailed and current ground-water information and, as a result, the first of the present series of Water Supply Reports was published by the Department of Conservation in 1957.

These reports are designed to supplement the Federal report series, and also provide interpretive text and illustrations. By means of these ground-water summaries basic information concerning ground-water conditions in Michigan are made readily available to the public.

Objectives of the Observation Well Program

The observation well program in Michigan is part of a nation-wide program the purpose of which was summarized by Sayre (Water-Supply Paper 1404, 1957) as follows:

"The objectives of the observation-well program are to provide a day-to-day evaluation of available ground-water supplies, to facilitate the prediction of trends in ground-water levels that will indicate the probable status of important ground-water supplies in the future, to delineate present or potential areas of detrimentally high or low ground-water levels, to aid in the prediction of the base flow of streams, to determine the several forces that act on a ground-water body, and to demonstrate the interplay of those forces in the ground-water regimen, to furnish information for use in basic research, and to provide long-

EXPLANATION

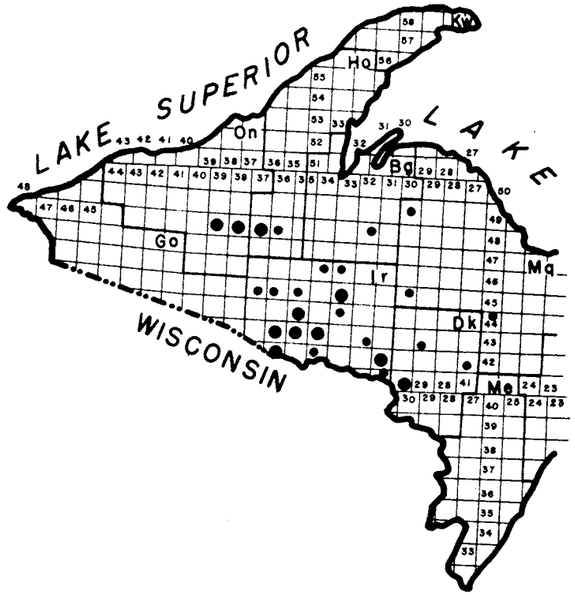
Observation well

Two or more observation wells

Diagram of geographical township

T. 47 N.	6	5	4	3	2	1
	7	8	9	10	11	12
	18	17	16	15	14	13
	19	20	21	22	23	24
	30	29	28	27	26	25
	31	32	33	34	35	36

R.9 W.



INDEX TO COUNTIES

Ac – Alcona
Ag – Alger
An – Allegan
Ap – Alpena
At – Antrim
Ar – Arenac
Bg – Baraga
By – Barry
Ba – Bay
Bz – Benzie
Be – Berrien
Br – Branch
Ch – Calhoun
Cs – Cass
Cv – Charlevoix
Cb – Cheboygan
Cp – Chippewa
Ce – Clare
Ct – Clinton
Cr – Crawford
De – Delta
Dk – Dickinson
Ea – Eaton
Em – Emmet
Ge – Genesee
Gw – Gladwin
Go – Gogebic
Gv – Grand Traverse
Gr – Gratiot
Hd – Hillsdale
Ho – Houghton
Hu – Huron
Ig – Ingham
Ia – Ionia
Ic – Iosco
Ir – Iron
Is – Isabella
Ja – Jackson
Ko – Kalamazoo
Ka – Kalkaska
Ke – Kent
Kw – Keweenaw
La – Lake
Lp – Lapeer
Ln – Leelanau
Lw – Lenawee
Lg – Livingston
Lu – Luce
Mc – Mackinac
Mb – Macomb
Ms – Manistee
Mq – Marquette
Ma – Mason
Mt – Mecosta
Me – Menominee
Md – Midland
Mk – Missaukee
Mo – Monroe
Mm – Montcalm
My – Montmorency
Mg – Muskegon
Ne – Newaygo
Oa – Oakland
Oc – Oceana
Og – Ogemaw
On – Ontonagon
Oe – Osceola
Od – Oscoda
Os – Otsego
Ot – Ottawa
Pr – Presque Isle
Ro – Roscommon
Sg – Saginaw
Sa – Sanilac
So – Schoolcraft
Sh – Shiawassee
Sc – St. Clair
Sp – St. Joseph
Tu – Tuscola
Va – Van Buren
Wa – Washtenaw
Wy – Wayne
We – Wexford

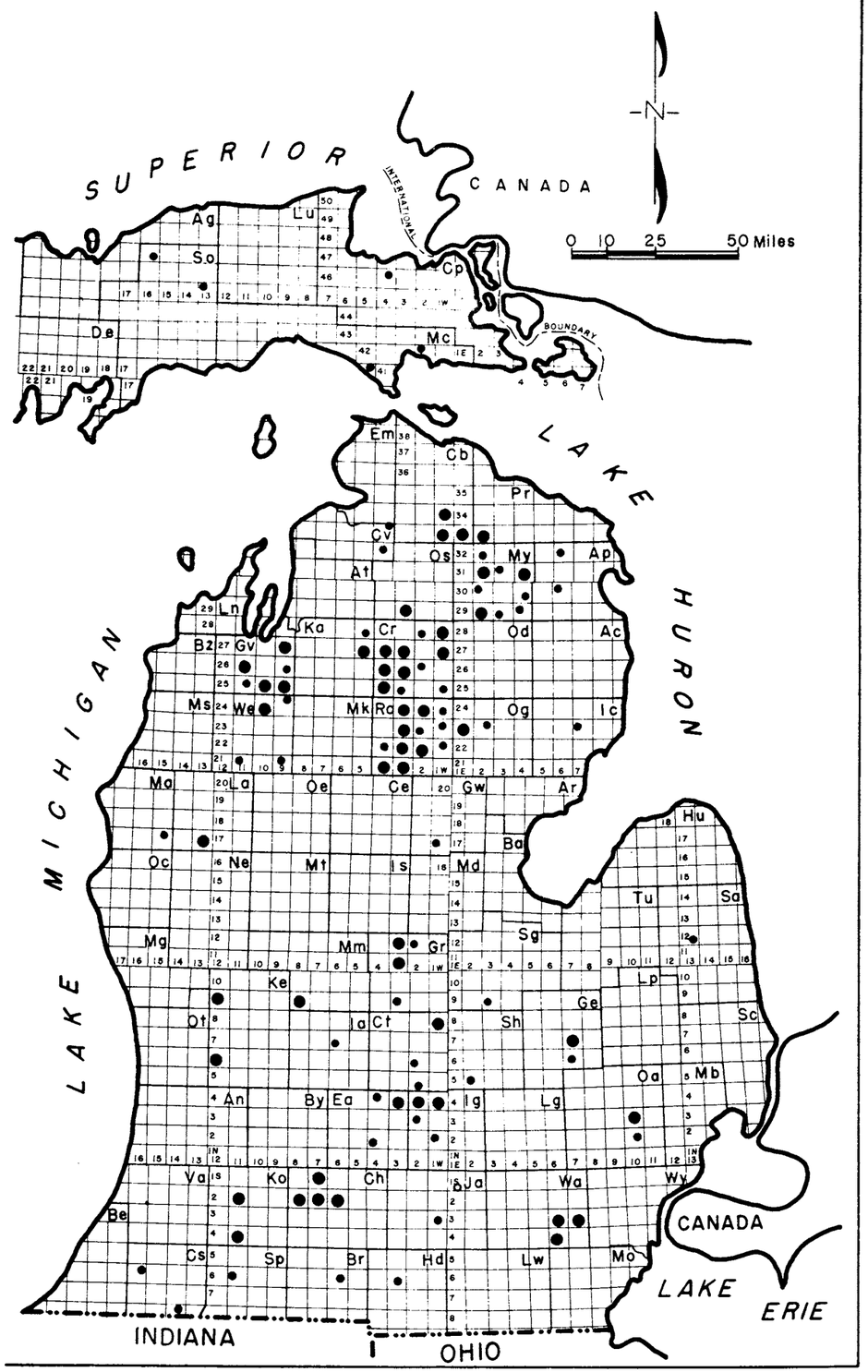


Figure 1.--Location of observation wells in Michigan.

term continuous records of fluctuations of water levels in representative wells. These selected records serve as a framework to which many short-term records collected during an intensive investigation may be related."

Scope of this Report

This report is based on periodic measurements of water levels made during 1957 in 288 observation wells. Continuous recording gages were in operation on 24 of the wells. The report summarizes water-level changes observed throughout the State, and analyzes these changes in selected areas. The geographic distribution of wells in which water levels were observed in 1957 is shown in figure 1.

Table 1 lists the basic information for each observation well, and Table 2 gives the range of fluctuation of water level in each observation well for 1957, as compared with the previous record. Fluctuations of water levels in representative wells are shown by numerous hydrographs, and in many cases graphic interpretations of the changes in water level are made by including pertinent climatic or pumpage data.

Open-File Records

Complete tabulations of water-level measurements and hydrographs for each observation well, records of chemical quality of ground water, water-temperature measurements, well records including logs, aquifer tests, records of pumping for public supply and industrial use, and published and unpublished water-resources reports are on file for public inspection. They may be examined at the Michigan district office of the U. S. Geological

Survey, Ground Water Branch, 407 Capitol Savings and Loan Building, Lansing, or at the Water Resources Section of the Michigan Geological Survey, 4th floor, Mason Building, Lansing. Records for the Northern Peninsula are also kept on file in the office of the Michigan Geological Survey, 203 State Office Building, Escanaba.

U. S. Geological Survey Water-Supply Papers are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., or can be consulted at the offices listed above or in major university and municipal libraries. The Federal Survey also issues a monthly publication entitled "Water Resources Review" which summarizes ground-water levels and streamflow throughout the United States. The monthly issues plus spring and annual summaries can be obtained free of charge by application to the Director, U. S. Geological Survey, Washington 25, D. C.

Progress reports of cooperative ground-water investigations covering specific areas of the State are published from time to time by the Michigan Department of Conservation. These reports are also available for inspection at the offices listed above. If not out of print, they can be purchased from the Michigan Department of Conservation, Publications Room, Mason Building, Lansing 26, Michigan. A list of publications including prices for each publication can also be obtained.

Well-Numbering System

The well-numbering system now used by the State and Federal Surveys in Michigan indicates the location of wells within the rectangular subdivisions of the public lands with reference to the Michigan meridian and base

line (fig. 1). The first two segments of a well number designate the township and range; the third segment designates both the section and a serial number arbitrarily assigned to each well within the section. Thus, well number 32N 6E 16-1 is well number 1 in section 16, Township 32 North, Range 6 East. In the several small areas of the State where the rectangular subdivisions have not been made, wells are numbered as above by projection of the rectangular subdivisions to those areas. Numbers formerly assigned to wells included herein are listed in table 1.

Acknowledgments

Acknowledgment is made to personnel of Federal and State agencies, industrial concerns, municipalities and public utilities who serve as voluntary water-level observers, and whose continuing effort has contributed to the accumulation of the basic data presented in this report.

Appreciation is also extended to Messrs. J. G. Rulison, Chief, Water Resources Section, Lansing, and A. E. Slaughter, Geologist, Escanaba, of the Michigan Geological Survey, for their assistance in the original planning and editing of this report series.

PRECIPITATION AND TEMPERATURE

Statewide precipitation was generally deficient during the winter and again in August. The heaviest precipitation in the Northern Peninsula was in May, July, September, and November and in the Southern Peninsula in the months April through July, and October.

The annual precipitation was at, or well above average in all but 2 of the 10 climatological divisions of the State as defined by the U. S. Weather Bureau. The two divisions with below-average annual rainfall were the western part of the Northern Peninsula where the deficiency was about 6 inches and the northwestern part of the Southern Peninsula where the deficiency was about an inch. Totals for the year ranged from 20 inches in the Keweenaw Peninsula to 40 inches in the southwestern part of the State.

January was unusually cold, but frequent mild spells in February, March, and April caused thawing of the snow cover. Temperatures from May through October were unseasonably cool. Periods of mild temperatures in November and December melted most of the snow cover that had accumulated during the latter part of the year. Temperature extremes for the year ranged from -31° F locally in the Northern Peninsula to +99° F at Greenville in the Southern Peninsula.

Several illustrations in this report include graphs showing the cumulative departures of precipitation from the published long-term mean. These graphs were constructed by adding, algebraically, the annual precipitation departures for the period of the hydrograph.

PRINCIPLES OF OCCURRENCE OF GROUND WATER

The source of ground water is precipitation, and the average annual precipitation over Michigan is about 30 inches. However, much of this water is lost by evaporation, transpiration, and surface runoff before any can enter the underground reservoirs.

The amount of precipitation which becomes ground water is influenced by a number of factors: the duration, intensity, and type of precipitation; the density and types of vegetation; the topography; and the porosity, permeability, and degree of saturation of the soil, subsoil, and underlying rock formations in the areas receiving precipitation.

An aquifer is a formation, part of a formation or several formations that yield water in usable quantities. Aquifers may be classified as water table or artesian. In a water-table aquifer ground water is unconfined and the upper surface of the saturated zone is termed the water table. In an artesian aquifer ground water is confined between relatively impermeable strata (strata through which water does not move readily) and is under artesian pressure. The water in a tightly cased well finished in an artesian aquifer will rise above the bottom of the upper confining bed, and, if under sufficient pressure, will flow at or above land surface.

The movement of ground water is somewhat similar to that of surface streams in that the water moves by gravity from high to low levels. Percolation of water through the pores, crevices, and minute interstices between rock particles below the surface involves a large amount of friction and hence is much slower than flow of water upon the surface. Rates of ground-water movement range widely, from a few feet per year to many feet per day.

Water may travel great distances underground from recharge areas (areas where precipitation can infiltrate into a ground-water reservoir), to areas downgradient where it may once more reach the surface and join the flow of streams, appear as a seep or spring, enter a lake, or escape directly to the atmosphere by means of evaporation and transpiration.

Water levels in wells are almost continually changing, with movement up or down varying from fractions of an inch per day to many feet in a short time. Water levels are influenced by many factors, including direct recharge from precipitation (fig. 6), pumping from nearby wells (fig. 22), evaporation and transpiration of water by vegetation (fig. 6), and by changes in water levels in both natural and man-made drainage systems (table 2, wells 7N 7E 29-1 and 29-2). In artesian wells, changes in water level or artesian pressure may occur quickly over large areas as the result of pumping or changes in pumping rate. Temporary influences on the level in artesian wells result from changes in atmospheric pressure, earthquakes, earthtides (fig. 14), and other factors.

Causes of Water-Level Fluctuations

Climatic Influences

Water levels fluctuate with seasonal changes in the rate of recharge to, and discharge from the aquifers. During the spring thaw, water levels in wells normally rise in response to recharge from infiltration of rain and melting snow. Summer temperatures cause an increase in evapotranspiration resulting in declines in water levels. Rainfall during the growing season generally has slight effect on the rate of decline as vegetation tends to utilize most of the available moisture.

Water from rains of high intensity and short duration, common in the summer months, tends to run off to surface streams. In the fall, after freezing temperatures end the growing season and transpiration ceases, precipitation may cause rises in water levels, however, the usual decline in stage during the summer may be continued by a deficiency of precipitation or by an early general freeze which tends to impede infiltration.

In much of the State, conditions were most favorable for groundwater recharge during February and March when frequent thaws occurred causing snowmelt, and in April when precipitation was well above average. In November and December periods of above-freezing temperatures also permitted snowmelt that resulted in considerable recharge to the aquifers. In addition, sharp rises in stage were observed during the summer as the result of heavy precipitation and relatively cool weather which reduced evapotranspiration. Thus, during the latter half of the year water levels throughout the State were generally higher than in 1956.

Pumping Influences

Generally, ground water is a renewable natural resource as it is intermittently or continually being replaced directly or indirectly by precipitation. If an aquifer is to be developed by means of wells so that a long-term yield can be obtained without substantially dewatering the aquifer, then equilibrium must exist between the rate of recharge to the aquifer and the rate of discharge from the aquifer. Any aquifer in its natural state (before it is tapped by wells) is in approximate dynamic equilibrium. When water is discharged from an aquifer by means of a well, an increase results, at least temporarily, in the rate of total discharge

from the aquifer. Pumping causes a cone-shaped depression in the water table or piezometric surface that expands with time around the discharging well. With continued discharge, the cone of depression will continue to expand until the resultant lowering of water levels causes a decrease in discharge from the aquifer, or an increase in recharge to the aquifer, or a combination of both, which restores the aquifer to a state of equilibrium.

Wells within the cone of depression are affected by the lowering of water levels or artesian pressures. Thus, a well tapping an aquifer may be affected by the discharge of other wells that tap the same aquifer. In the case of several of many discharging wells, a composite cone of depression results that may extend over a large area. The result of the lowering of water levels over a large area may cause a considerable increase in the rate of recharge to, or a considerable decrease in the rate of natural discharge from, the aquifer. A lowering of the water level, therefore, is necessary in the utilization of a ground-water reservoir or aquifer.

Withdrawals of ground water by municipalities and industry are discussed under the various county headings. Pumpage totals are included in some of the illustrations to show their effect on the water level in nearby observation wells.

SUMMARIES OF GROUND-WATER CONDITIONS

Statewide Changes in Natural Storage

Figure 2 shows hydrographs of month-end water levels, plotted with the month-end averages and extremes for the previous record, in selected observation wells throughout the State. The wells are in areas of little or no pumping and reflect changes in aquifer storage in response to natural conditions.

During the early part of the year the water levels in wells of the Southern Peninsula were below average, but by midyear, rises to above-average levels in response to heavy precipitation were recorded, except in the southwestern part.

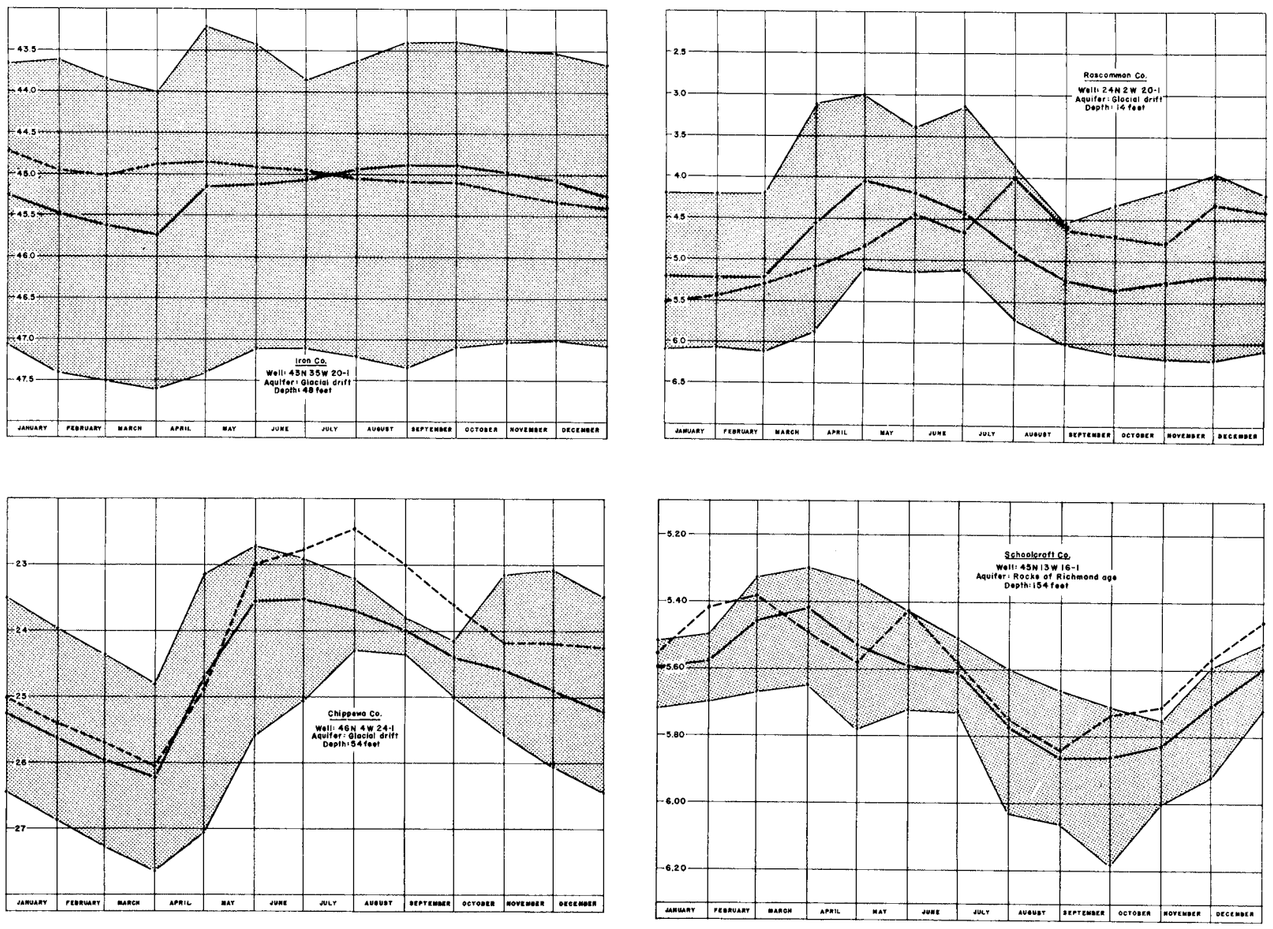
In the eastern half of the Northern Peninsula water levels ranged from above average to new highs for the period of record. In the western half water levels declined below average during the latter part of the year as the result of cumulative deficiencies of precipitation.

The water levels in wells which reflect natural conditions serve as a basis for comparison with fluctuations in those wells which are affected by pumping.

Northern Peninsula

Western Half

Most of the wells presently observed in the western half of the Northern Peninsula are those maintained by the Wisconsin-Michigan Power Co. to evaluate ground-water storage and aid in the prediction of stream flow in the Menominee River Basin. Most of these wells are finished at shallow



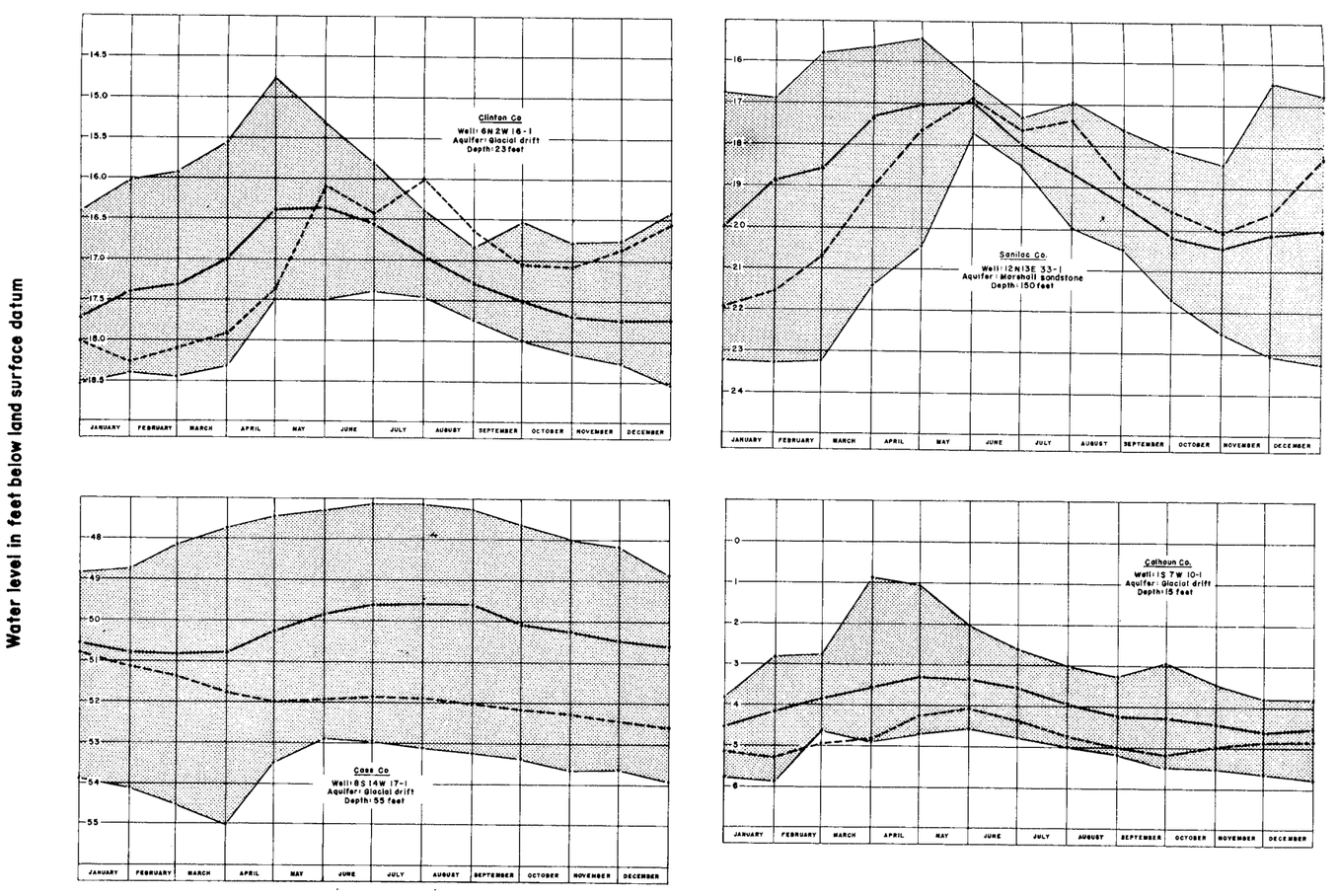


Figure 2. Month-end water levels in key observation wells.

EXPLANATION

Levels in 1957

Average for the period of record through 1956

Extremes for the period of record through 1956

depth in glacial-drift deposits of Pleistocene age and reflect changes in natural storage in the ground-water reservoirs. Ground-water levels declined seasonally until March when above-freezing temperatures during the daytime hours caused snowmelt and brought substantial rises in stage. Cold weather during the early part of April was followed by an unusually mild spell during the latter part of the month when the remainder of the snow cover melted and the spring rise of water levels continued. The seasonal decline began in May with the start of the growing season and continued at an increased rate as deficiencies of precipitation increased during June and July. At the end of July levels in wells were at or near record low stages for that month and continued to decline through August. Above-average rainfall at the end of August and in September resulted in a small rise in water levels but the levels declined again during October when precipitation was only 65 percent of normal. Precipitation mostly as snow, combined with periods of above-freezing temperatures melted the snow cover and resulted in rising water levels through mid-December. Year-end stages were about a half foot higher than at the end of 1956. Despite a deficiency of about 4 inches of precipitation for the year, ground-water reservoirs were benefited by rainfall during periods favorable for recharge.

Figure 3 illustrates the effect of seasonal changes of temperature on the water level in a shallow water-table well in Dickinson County.

Figure 4 depicts the effect of the departure of total annual precipitation from average on the water level in a shallow water-table well in Marquette County.

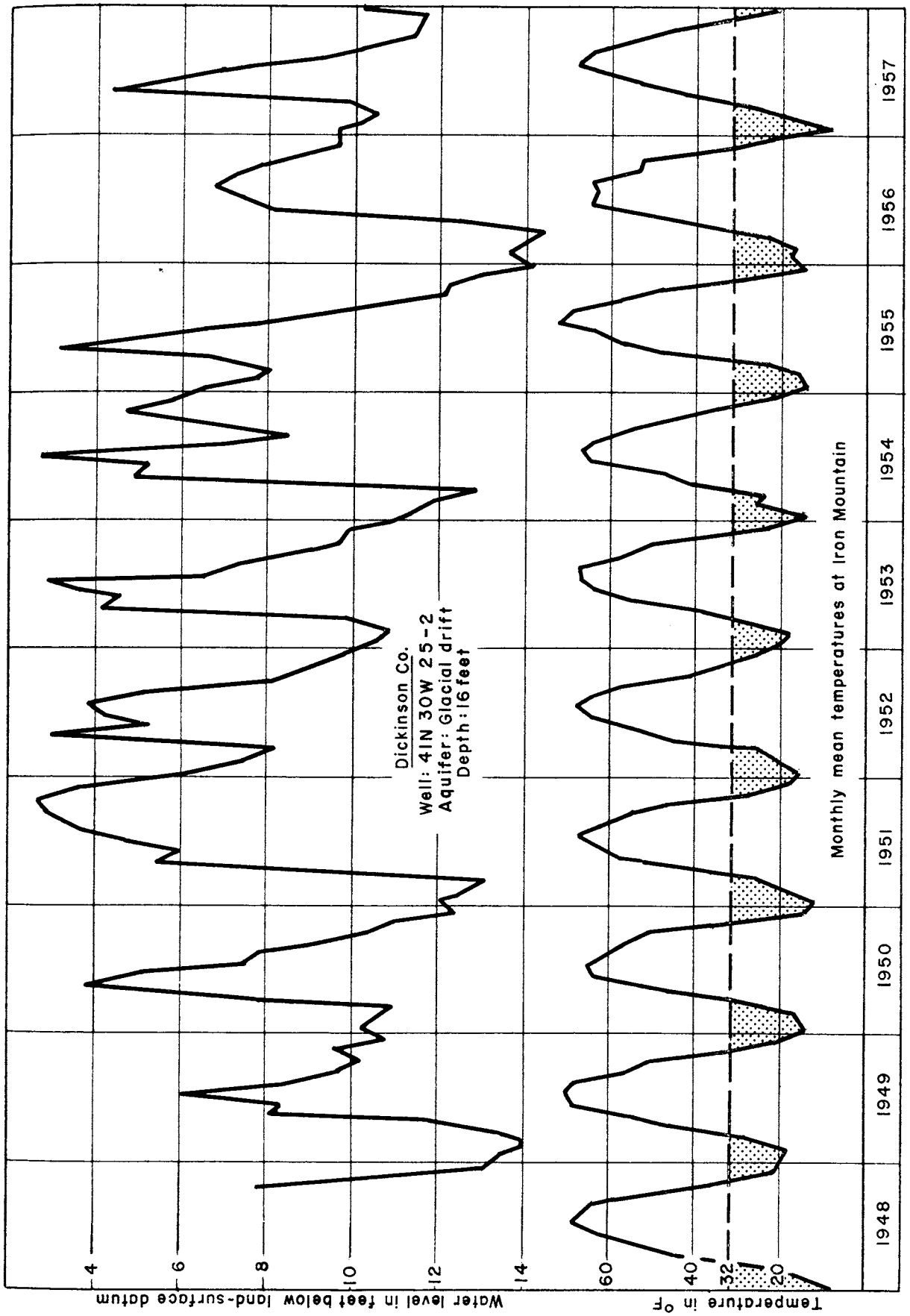


Figure 3.--Hydrograph of well 41N 30W 25-2, and monthly mean temperatures at Iron Mountain, 1948-57.

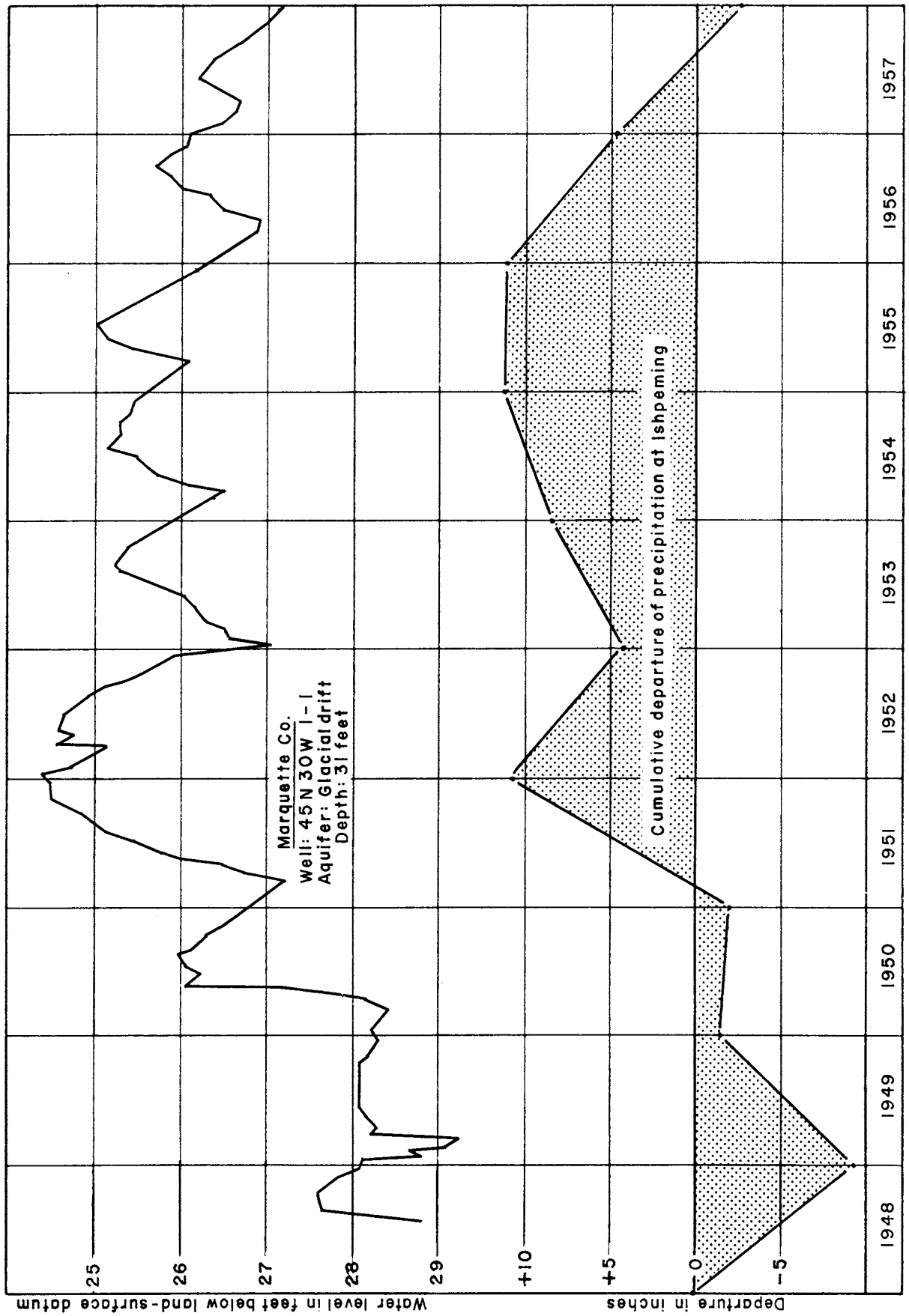


Figure 4.--Hydrograph of well 45N 30W 1-1 and cumulative departure of precipitation from long-term mean at Ishpeming, 1948-57.

Figure 4.--Hydrograph of well 45N 30W 1-1 and cumulative departure of precipitation from long-term mean at Ishpeming, 1948-57.

Eastern half

Chippewa County.--Well 46N 4W 24-1, near Raco, (fig. 2) is finished in glacial drift, and reflects natural conditions of climate. The water level responds readily to changes in total precipitation and also to the effects of seasonal changes in temperature. A continuous record is obtained by means of a recording gage.

Recharge to the aquifer from snowmelt and precipitation in April ended the seasonal winter decline. The water level rose during the spring and continued to rise through July as the result of more than 14 inches of precipitation during the period April through July. As a result, new highs of record were reached in June and July. Despite deficient precipitation in the period August through October, the August and September levels remained the highest observed during the past 5 years. Recharge resulting from above-average precipitation and temperatures, in November and December, prevented the usual seasonal decline. The year-end level was about a foot above average.

Mackinac County.--Observation of water levels by means of recording gages was continued in 1957 on two wells in this county.

Well 42N 2W 7-1 at Ponchartrain Shores is finished in the Engadine dolomite of Middle Silurian (Niagara) age. Precipitation and above-freezing daytime temperatures in late March and early April resulted in recharge to the aquifer from the melting of about two feet of snow, so that by late May the stage had risen more than eight feet. Evapotranspiration at the start of the growing season, however, ended the rise and the level declined 5 feet during June. Heavy rains in late June and early July

caused a sharp rise of 9 feet, to the highest water level of the year. The level then declined until early November when a sharp rise of several feet occurred as the result of about $2\frac{1}{2}$ inches of precipitation during a period of a few days.

Well 41N 5W 23-1 at Round Lake is finished in the Salina formation of Late Silurian age. Snowmelt in mid-March and early April caused water levels to rise from late March to mid-April when the highest level of the year was observed. The seasonal decline which followed, although reversed several times by short periods of heavy rainfall, continued until mid-November when a steep rise resulted from intense precipitation.

Year-end water levels in these wells were more than 1/2 foot higher than at the beginning of the year.

Schoolcraft County.--Well 45N 13W 16-1 at the Seney Wildlife Refuge near Germfask, reflects changes in artesian pressure in limestone strata equivalent to the upper part of the Richmond group of Late Ordovician age. The well is equipped with a recording gage. The stage (fig. 2) generally was above average during the year. Levels rose in January and February in response to recharge in late 1956, but declined in March and April. At the end of May, however, following 6 inches of precipitation during the month the water level equaled the high of the 1952-56 record. Water levels during the last quarter of 1957 reached record monthly highs as a result of about 11 inches of precipitation in the September-December period.

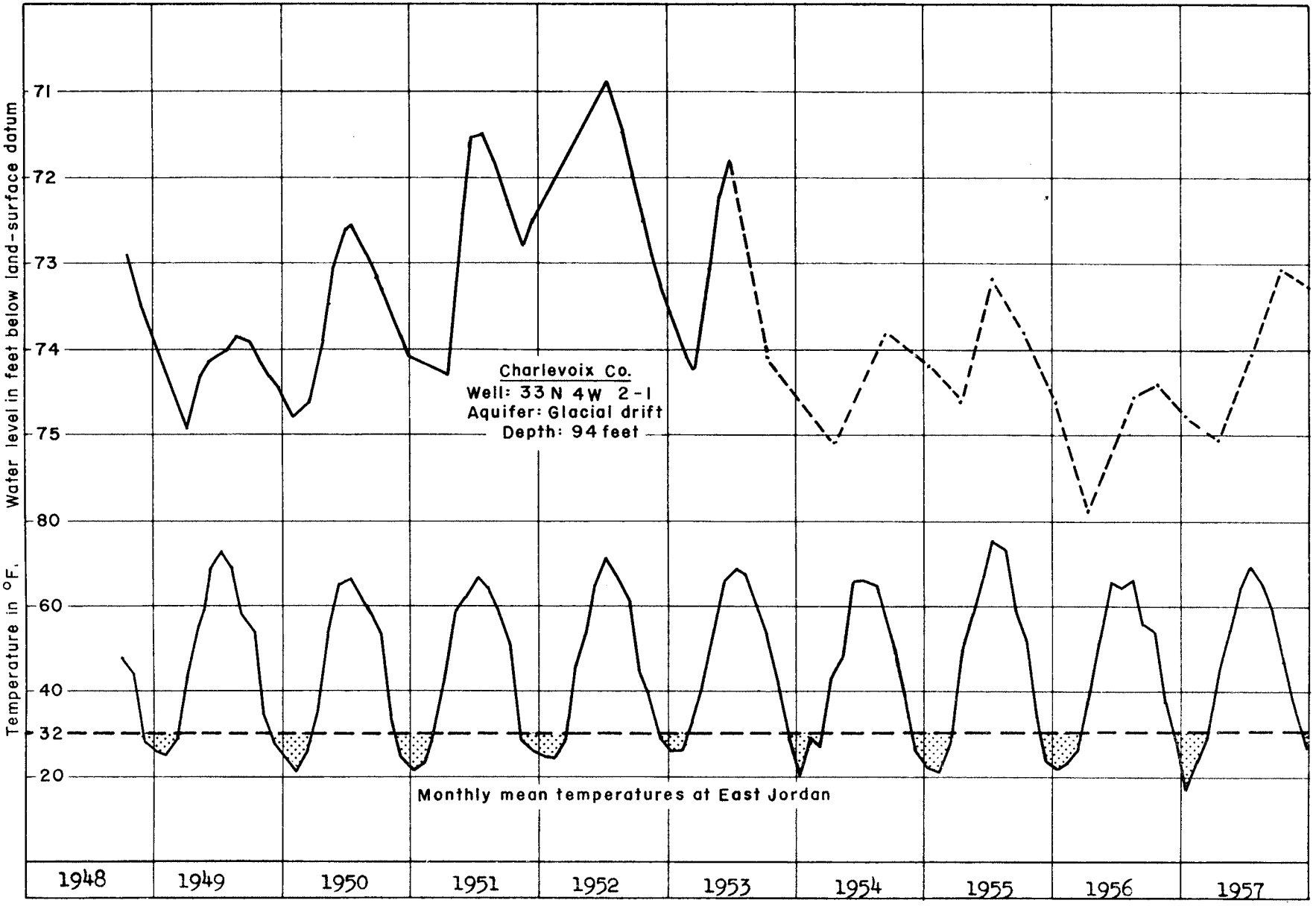


Figure 5.--Hydrograph of well 33N 4W 2-1 and monthly mean temperatures at East Jordan, 1948-57.

Figure 5.--Hydrograph of well 33N 4W 2-1 and monthly mean temperatures at East Jordan, 1948-57.

Southern Peninsula

Northern Half

Roscommon County.--Well 24N 2W 20-1, near Roscommon, is used as an index of trends of ground-water level in the shallow drift aquifers in the northern half of the Southern Peninsula. The water level (fig. 2) was below average throughout the first half of the year as the result of accumulated deficiencies in precipitation in the fall and winter of 1956-57. Nearly 10 inches of rain fell during June and July, however, and the level rose sharply to the highest stage for the year in late July The seasonal decline was resumed in August and continued till mid-November. Normally, seasonal declines are ended by October. Precipitation, and snowmelt caused by above-freezing temperatures, in November and December, recharged the ground-water reservoirs and resulted in a rise in water level. At the end of the year the stage was about a foot higher than at the beginning.

Charlevoix County.--Well 33N 4W 2-1, at the site of the former Wolverine CCC camp, is finished in glacial drift. Figure 5 shows the effect of seasonal changes in temperature on the water level in this well. The correlation of temperatures and water levels is typical of wells finished at depth in glacial drift in the northern counties of the Southern Peninsula. The lag in recharge to the deeper aquifers, owing to the distance precipitation has to percolate through the ground, results in high water levels in midsummer, a time when water levels in shallow drift wells normally decline (see fig. 7). As shown by the illustration (fig. 5) the water is at low stage during the winter when frozen ground, and precipitation occurring as snow, preclude recharge. (The dashed lines on the hydrograph

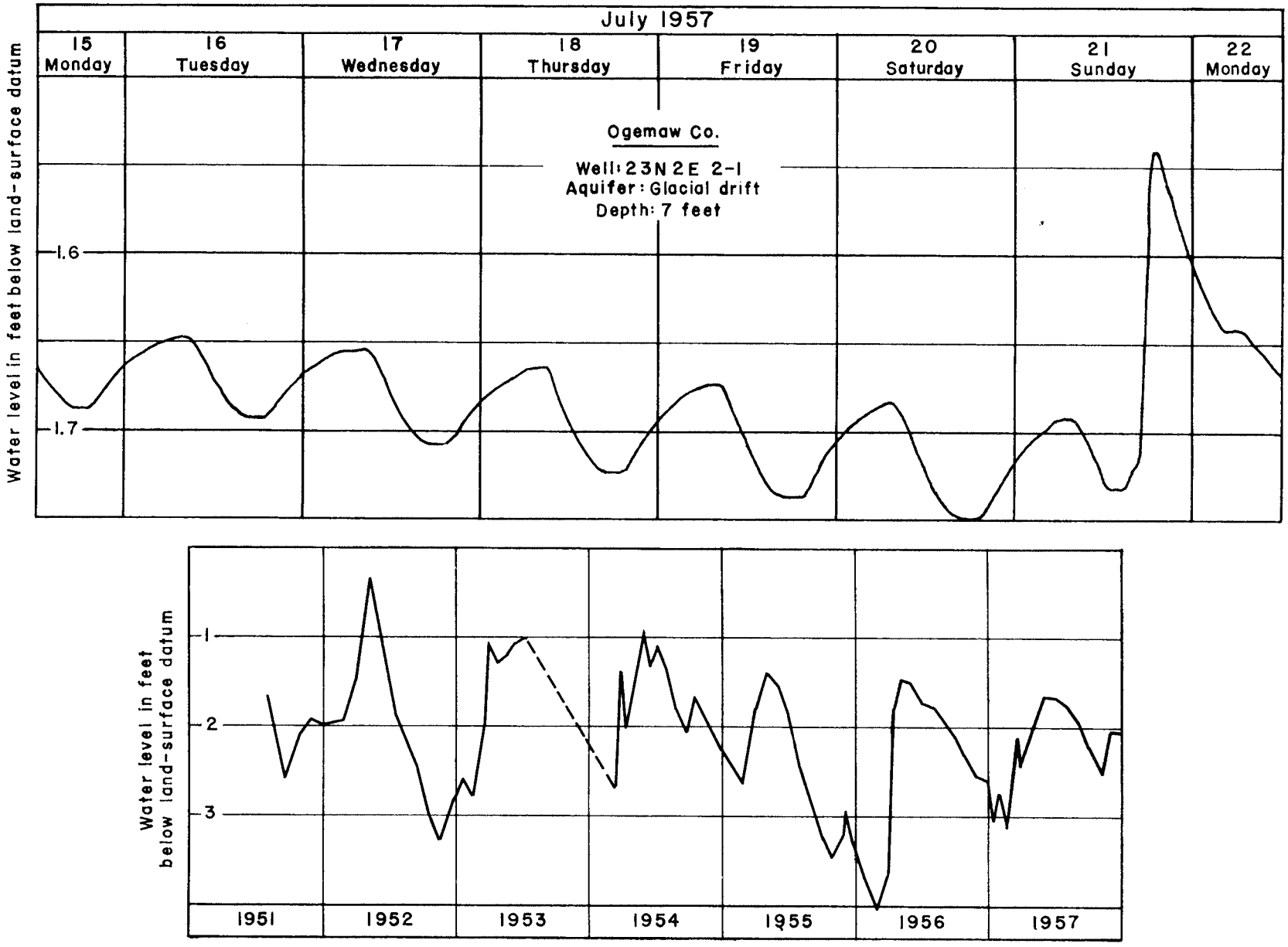


Figure 6.--Hydrograph of well 23N 2E 2-1 near Rose City for the period 1951-57 and for the week ending July 22, 1957.

indicate infrequent measurements as contrasted to the early part of the record, which was taken from a recording gage.) The high water level for the year 1957 was the highest observed since 1953, and was about 3 feet above the low stage observed in 1956. The water level showed a net rise of about a foot for the year, owing to favorable conditions of temperature and precipitation late in the year.

Ogemaw County.--Well 23N 2E 2-1 is dug 7 feet deep into glacial drift. The upper part of figure 6 shows a reproduction of part of a graph taken from the recording gage on the well. This portion of record illustrates the effect of evaporation from the land surface and transpiration by vegetation during the daylight hours of each day. The sharp rise on Sunday afternoon resulted from about one inch of precipitation that fell during the hours from 5 to 9 p.m. During the growing season the general trend of the water level is downward and the daily transpiration and evaporation phenomenon is superimposed on this downward trend.

The lower half of the illustration is the water-level record for the period 1951-57. The low of record was reached in early 1956, and since then the water level has risen to an about-average stage. The net gain of about a foot for the year was due primarily to favorable precipitation and temperature conditions late in the year.

Mason and Wexford Counties.--The water levels in shallow well 17N 15W 3-1, (Mason County) and in a deeper well 21N 11W 13-1 (Wexford County) both finished in glacial drift, reflect natural conditions of recharge and discharge. Precipitation was deficient from 1955 through 1957

ending July 22, 1957.

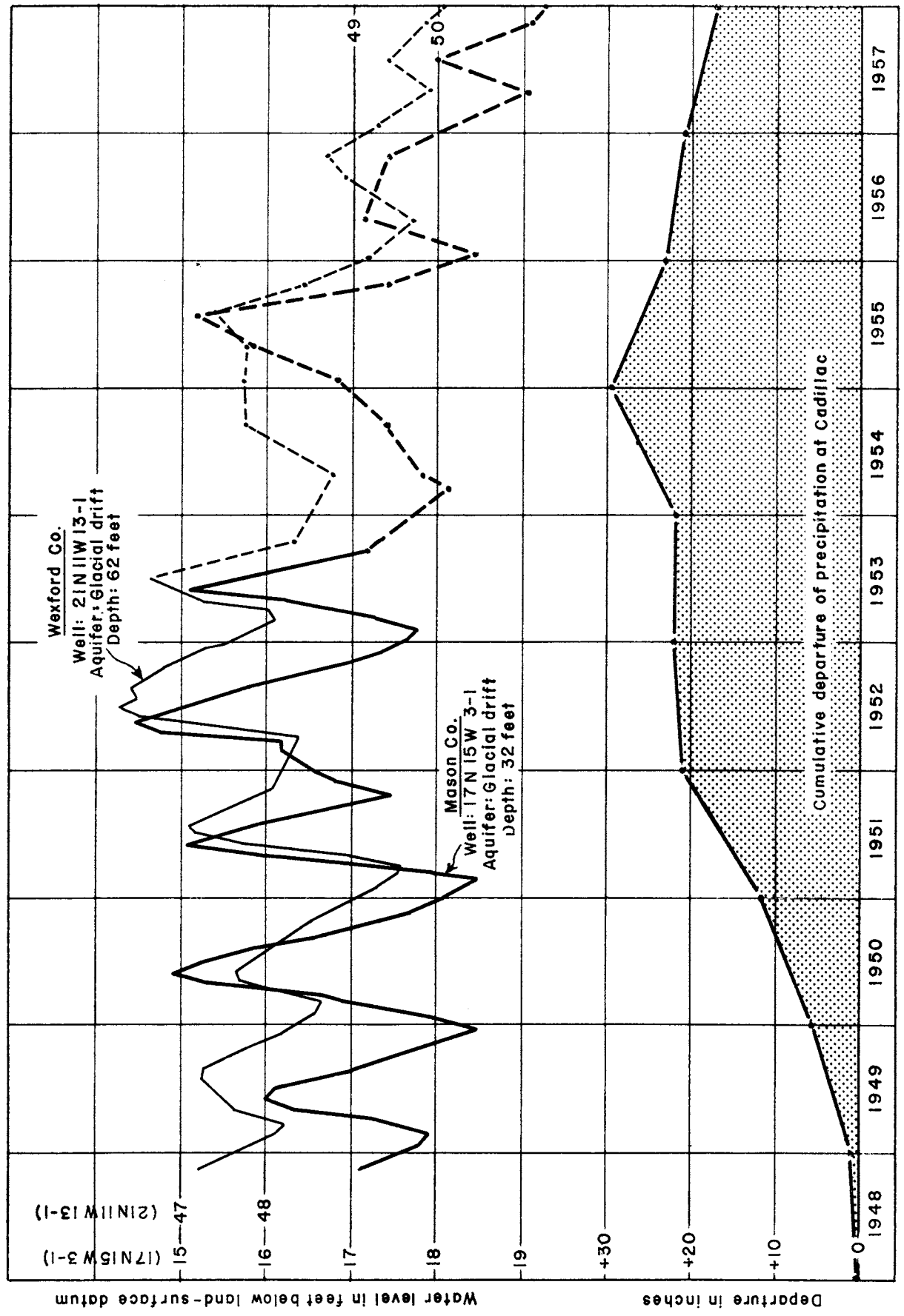


Figure 7.--Hydrographs of wells 17N 15W 3-1 and 21N 11W 13-1 and cumulative departure of precipitation at Cadillac, 1948-57.

and, consequently, in 1957 the levels in the wells continued the general decline of the past two years. Figure 7 shows the fluctuations of water level in the two wells, and illustrates the difference in the time of occurrence of the seasonal rises and declines of water level in shallow and deeper water-table aquifers. The large rises, which occur early in the spring, in the Mason County well are typical of water-table wells finished at shallow depths. The smaller and later fluctuations of water level in the deeper Wexford County well illustrates the lag in time of recharge to and discharge of water from the deeper aquifer. (The dashed lines on the hydrographs indicate infrequent measurements of water level in contrast to the previous record obtained from recording gages.)

It is interesting to note that although the total cumulative departure of precipitation was about 20 inches above the average during the years 1949 through 1951, the rise in water level was not as great as the decline in water level that occurred with a deficiency of about 13 inches of precipitation during the years 1955 through 1957. This illustrates the fact that the total amount of precipitation does not wholly determine the amount of recharge to an aquifer. The duration and intensity of rainfall, evapotranspiration demands, and degree of saturation of the soil zone above the aquifer at the time of precipitation, also influence the amount of water recharged to the aquifer.

Southern Half

Ground-water levels in areas of the southern half of the Southern Peninsula (fig. 2), where little or no pumping occurs, were generally well

below average from January through April, but levels were higher than in the same months of 1956. The low stages at the beginning of the year were the result of an unusually dry fall in 1956. The first quarter of 1957 was dry also but frequent thaws during the winter locally caused small rises in ground-water levels. Early spring rains, however, resulted in only moderate recharge because the growing season started early and most of the rain was needed to replace soil moisture depleted by vegetation.

From May through July generally heavy rainfall resulted in rises in ground-water levels. Locally, in the central and eastern part of the area water levels rose to the highest of record for July, but in the southwestern part they remained below average.

Seasonal declines were general during the remainder of the summer and early fall. In November and December above-normal precipitation and snowmelt resulted in recharge to various ground-water reservoirs and levels at the end of 1957 generally were higher than at the end of 1956.

Branch County.--Observation well 6S 6W 22-1 is finished in glacial drift, and is in the municipal well field in Coldwater. The water level is affected by withdrawals of ground water by the municipal wells tapping the same aquifer.

As a result of a dry fall in 1956 and the increase in pumping during those months, the water level at the beginning of 1957 was the lowest since 1954. The high stage for the spring of 1957 was the lowest spring high reached during the period of record. Deficiencies of precipitation in late spring and in September and heavy pumping in the summer combined

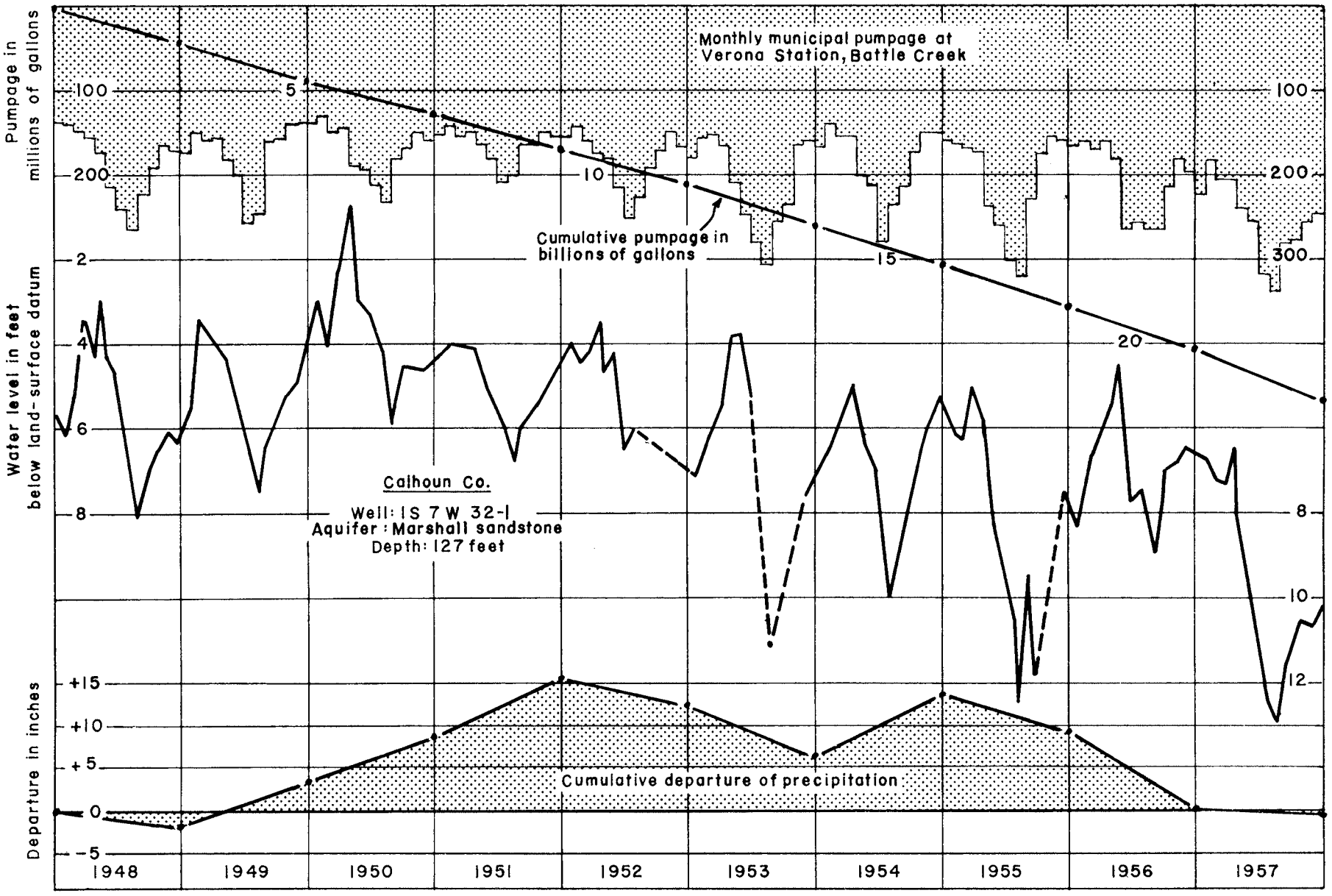


Figure 8.--Hydrograph of well 1S 7W 32-1 at Battle Creek, monthly and cumulative municipal pumpage, and cumulative departure of precipitation, 1948-57.

to cause low stages of record in the summer and early fall. In the last quarter of the year, however, above-average precipitation and decreased pumping permitted substantial recovery of water level and a net gain in stage of about 2 feet was registered for the year.

Municipal pumpage of ground water was a record 404 million gallons in 1957 and exceeded the previous high pumpage of 1953 by 40 million gallons.

Calhoun County

City of Battle Creek.--Most observation wells and municipal and industrial wells in the Battle Creek area are finished in the Marshall sandstone of Mississippian age. A few are finished in glacial drift.

At Battle Creek's municipal well field (Verona Station) the water level in observation well 1S 7W 32-1 (fig. 8) showed little response to spring ground-water recharge because of record high pumpage by the city. In July a large local industry discontinued use of its own wells and substituted municipal water. Municipal pumpage of ground water at the Verona Station was a record 3.04 billion gallons in 1957, an increase of 544 million gallons over 1956. As a result of increased pumpage, the level in the observation well was the lowest of record by August. The level at the end of 1957 was about $1\frac{1}{2}$ feet lower than at the end of 1956, although the annual precipitation was about average, as was the total precipitation for the period 1948-57.

Elsewhere in the Battle Creek area, water levels were below average at the beginning of the year as a result of precipitation deficiencies during the past 2 years and especially in the fall of 1956. Spring rises in water level were less than average and by early fall the levels were at

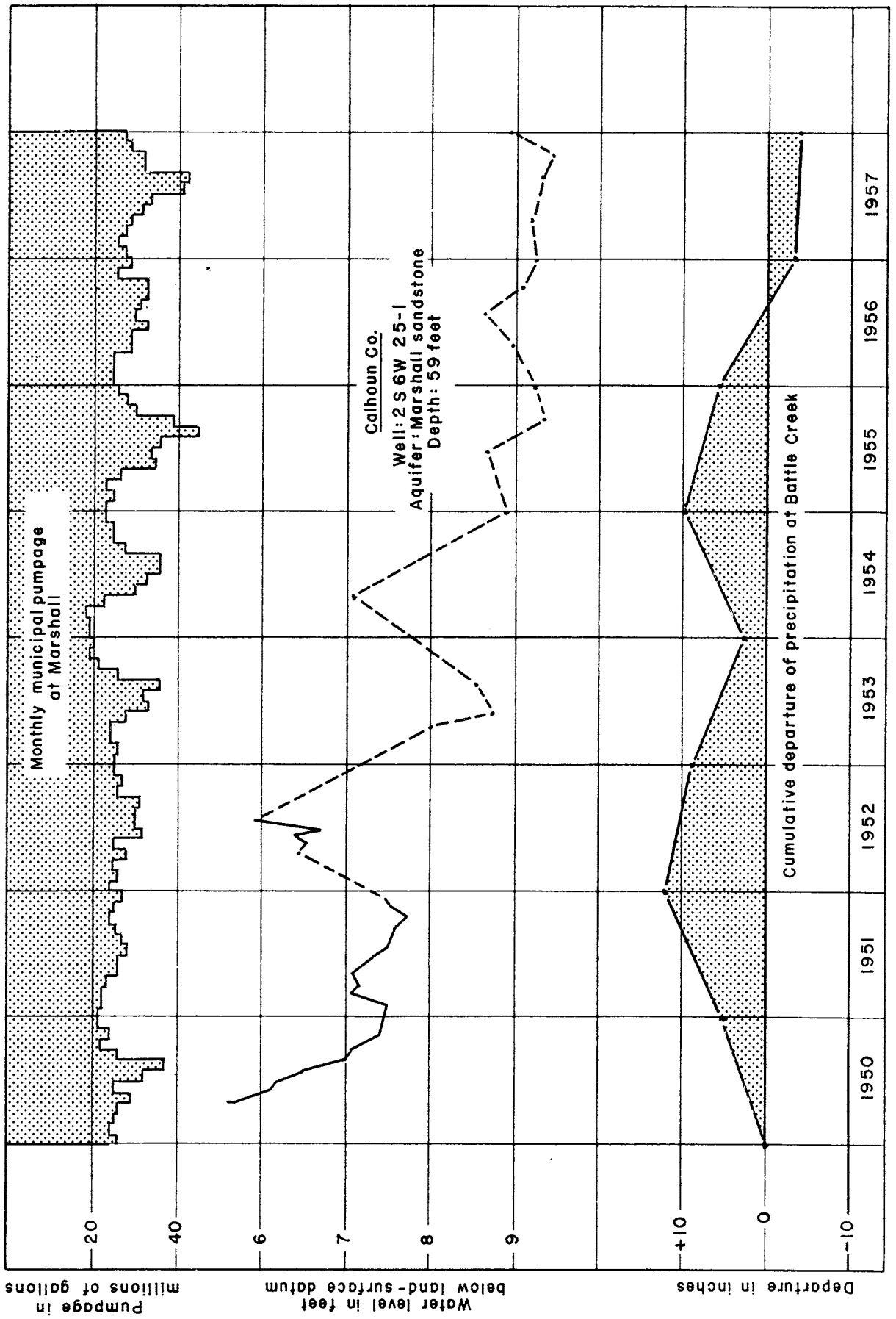


Figure 9.--Hydrograph of well 2S 6W 25-1 at Marshall, monthly municipal pumpage, and cumulative departure of precipitation, 1950-57.

or near lows of record of the past decade (table 2). During the last three months of the year, however, precipitation and snowmelt during periods of above-freezing temperatures caused water levels in most wells to rise above those observed at the end of 1956. The exceptions were those wells in the area affected by pumping from the Verona well field.

City of Marshall.--The three observation wells in the City of Marshall are finished in the Marshall sandstone and reflect municipal and industrial withdrawals of ground water from that aquifer.

Figure 9 illustrates the gradual decline of water level in observation well 2S 6W 25-1 (Ferguson Well) near the municipal well field which resulted from increased pumpage and deficient precipitation for the period 1950-57. In the fall of 1957 the water level was at the lowest stage for the seven-year period of record.

The water level in well 2S 6W 25-2 (Egeler Well) followed much the same pattern, but the level in well 2S 6W 25-3 (Filkin Well) which had declined 6 feet in the 1950-56 period, rose 2 feet during the year partly because of a reduction in pumping of ground water for cooling by the City's power plant.

Total pumpage for the year was 381 million gallons, the greatest for the period of record.

Cass County.--Observation well 6S 16W 1-1, in Dowagiac, is finished in glacial drift sand and gravel and is affected by pumping of the nearby municipal wells tapping the same aquifer (fig. 10).

The generally low water level in the observation well during the year was partly the result of the dry fall of 1956. Heavy rainfall in

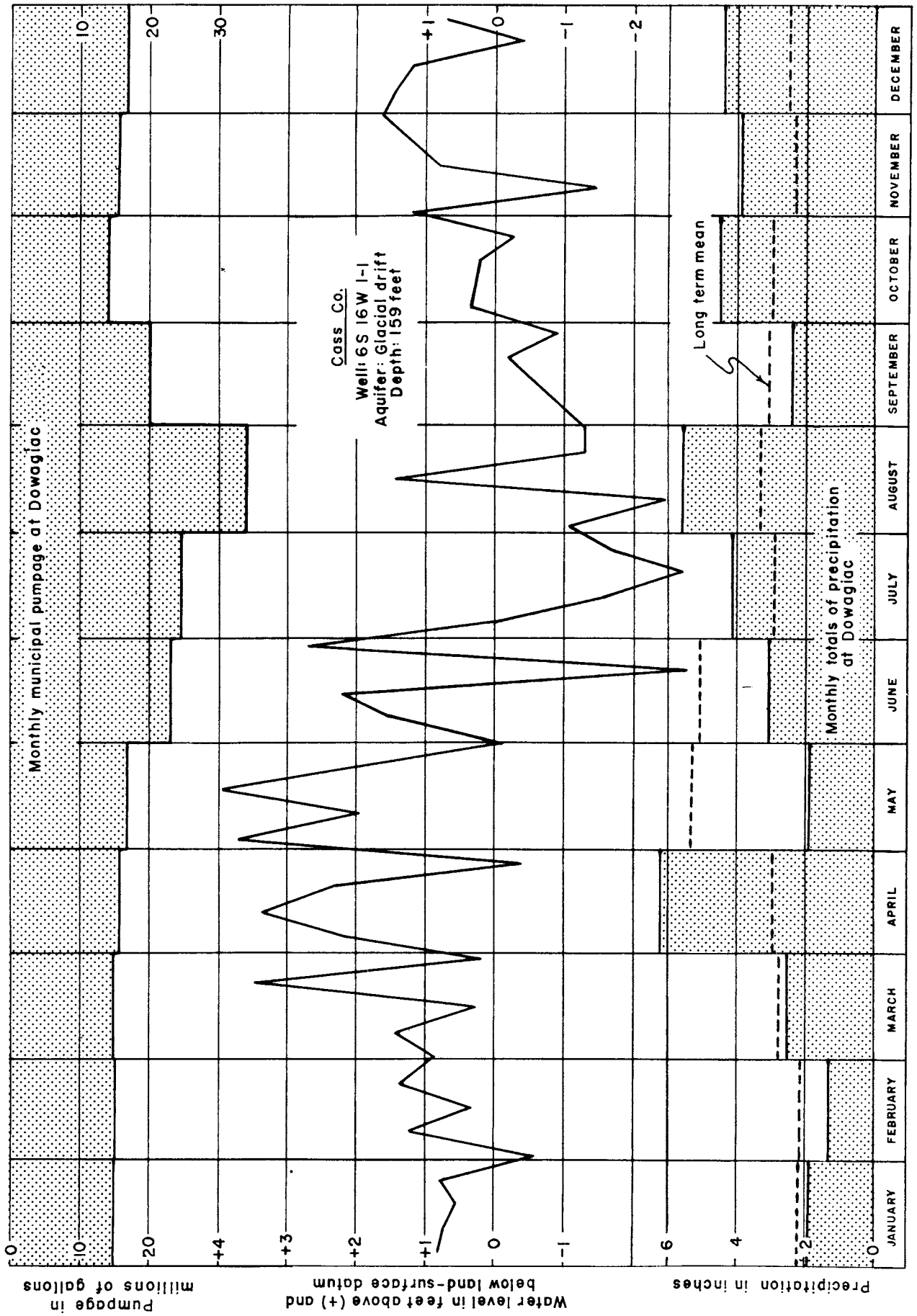


Figure 10.--Hydrograph of well 6S 16W 1-1 at Dowagiac, monthly municipal pumpage, and monthly totals of precipitation, 1957.

April of 1957 was followed by large deficiencies of precipitation in May and June that caused the water level to drop sharply in June. Precipitation in July and August was above average and moderated the usual summer decline of water level. Rainfall and snowmelt during the last three months of the year recharged the aquifer and as a consequence, levels at the end of the year were about the same as at the end of 1956.

No persistent decline of water level has been observed at the Dowagiac municipal well field except for the 1952-53 period when record-high municipal pumpage combined with light precipitation resulted in record-low levels. Since 1953 pumping has been reduced because a large local industry discontinued the use of city water and the levels in the observation well during 1957 were about the same as in 1950. Total municipal pumpage for the year was 224 million gallons and averaged 620,000 gallons per day (gpd) as compared with 645,000 gpd in 1956, and 1,300,000 gpd in the high pumpage year of 1953.

precipitation, 1957.

Clinton County.--The water level in observation well 8N 1W 13-1, finished in the Saginaw formation at Elsie, is affected by municipal pumping from the same aquifer. A new low for the period of record was observed in October. This low water level probably reflects increased pumping from the Saginaw formation by the Village of Elsie. Favorable recharge conditions in November and December caused water levels to rise to a stage near that observed at the end of 1956.

In the observation well 8N 1W 13-3, finished in glacial drift, levels at the end of 1957 were lower than at the end of the previous year.

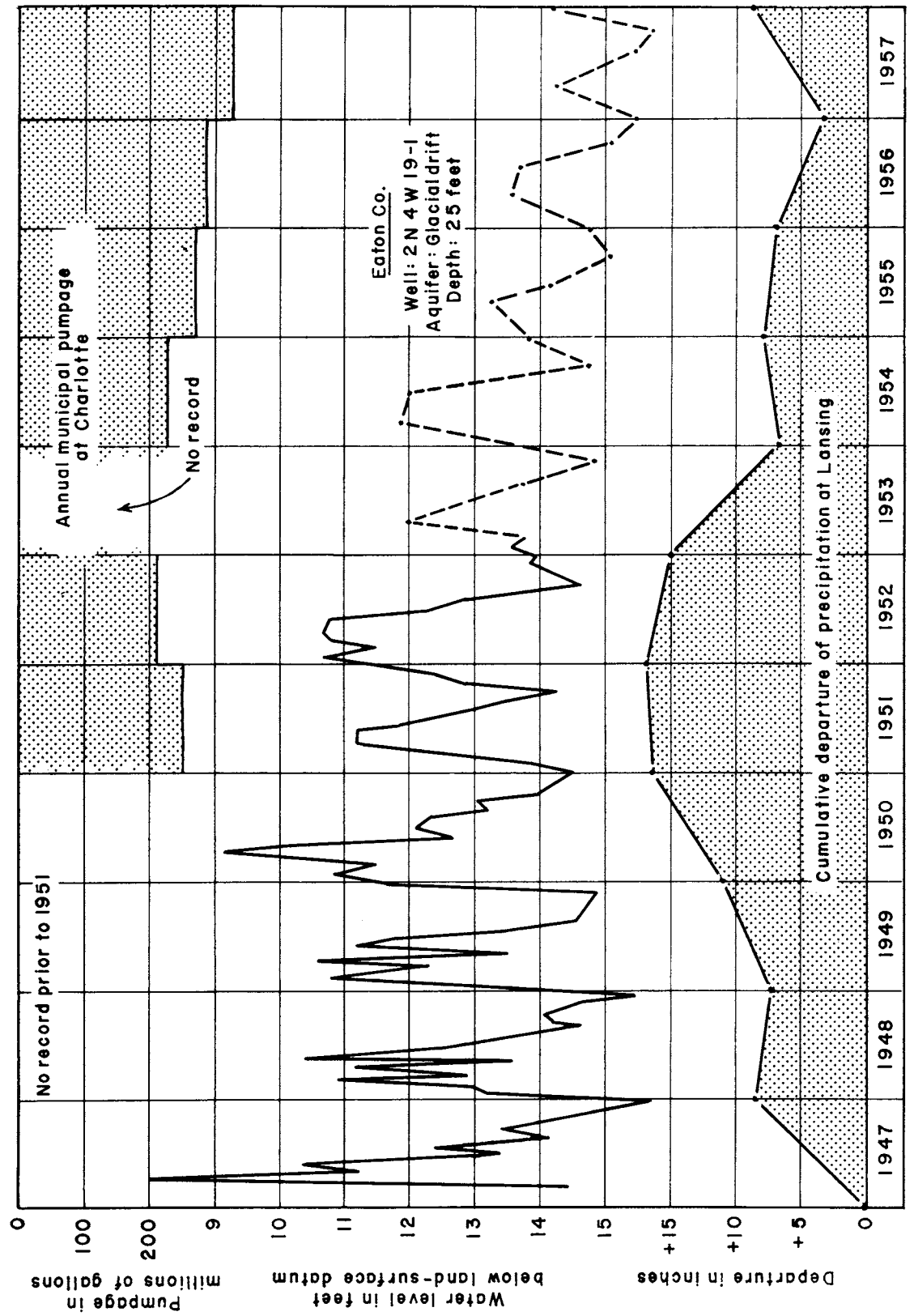


Figure 11.--Hydrograph of well 2N 4W 19-1 at Charlotte, annual municipal pumpage, and cumulative departure of precipitation, 1947-57.

Observation well 6N 2W 16-1, about 10 miles north of Lansing, is finished at shallow depth in the glacial drift. Water levels were below average during the first part of the year, but reached record highs for the months of July and August (fig. 2) in response to heavy rainfall during those months. The water level in this well remained above average for the rest of the year.

Eaton County

City of Charlotte.--Observation well 2N 4W 19-1, and all municipal wells at the municipal park in Charlotte are finished in glacial drift. The water level in the observation well is affected by municipal pumping but also reflects natural conditions of recharge and discharge. In October the water level declined to the lowest level observed since 1947. Precipitation in the fall and snowmelt at the end of the year, however, brought increased recharge and the level at the end of 1957 was higher than at the end of 1956.

As shown by figure 11, the water level generally reflected precipitation trends during the 1947-57 period. The earlier part of the record was obtained from a recording gage. Periodic measurements have been made since late 1950.

Total municipal pumpage in 1957 was 324 million gallons, and averaged nearly 890,000 gpd. Pumpage totals for the years for which records are available are shown in figure 11.

City of Grand Ledge.--Observation well 4N 4W 2-1 and the municipal wells in Grand Ledge are finished in the Saginaw formation. The water

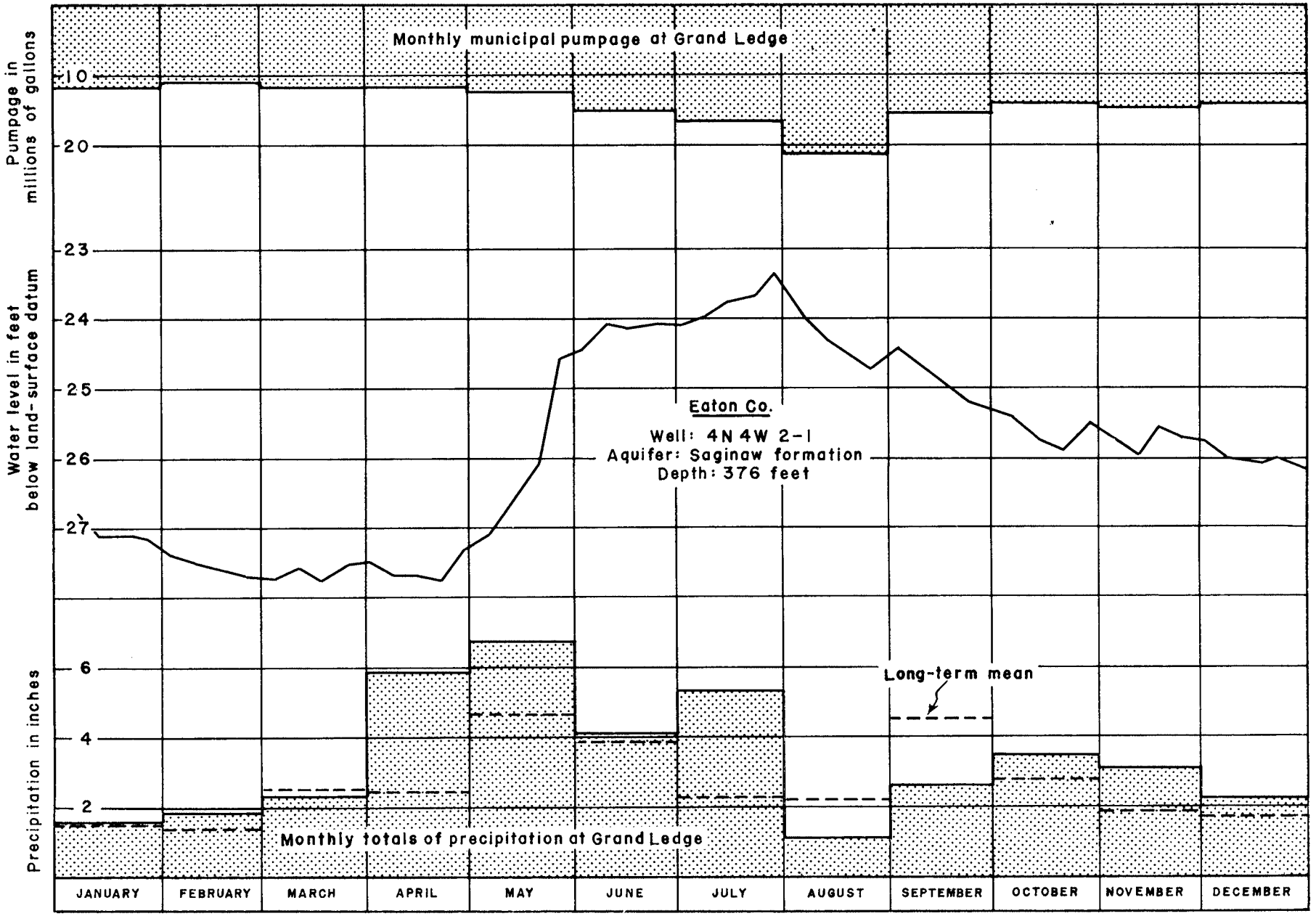


Figure 12.--Hydrograph of well 4N 4W 2-1 at Grand Ledge, monthly municipal pumpage, and monthly totals of precipitation, 1957.

level in the observation well (fig. 12) rose in response to above-average precipitation during the period April through July. Increased pumping and a dry August caused water levels to decline. The decline was moderated by above-average precipitation during the remainder of the year. The levels in the observation well at the end of 1957 were about a foot higher than at the end of 1956 primarily as a result of precipitation during the year which was nearly nine inches above average.

precipitation, 1957.

Total municipal pumpage of ground water from the Saginaw formation at Grand Ledge in 1957 was 172 million gallons, an increase of 11 million gallons over 1956.

Other observation wells in Delta Township of Eaton County are discussed under the heading, "Lansing Metropolitan Area".

Genesee County.--The City of Flint obtains its municipal water supply from the Flint River. However, Burton Township to the south, Beecher Metropolitan Water District to the north, and many industries in the area obtain water from the Saginaw formation. Observation wells in the Flint area show fluctuations of water levels in the Saginaw formation, deep glacial drift aquifers, and in the shallow drift deposits.

In the spring of 1957 levels in observation wells were the highest of the past several years as the result of above-average precipitation in 1956 which continued in 1957. Levels at the end of 1957 were about the same as at the end of 1956.

Figure 13 illustrates the effect of pumping and precipitation on the water level in observation well 6N 7E 9-1, at the Fisher Body

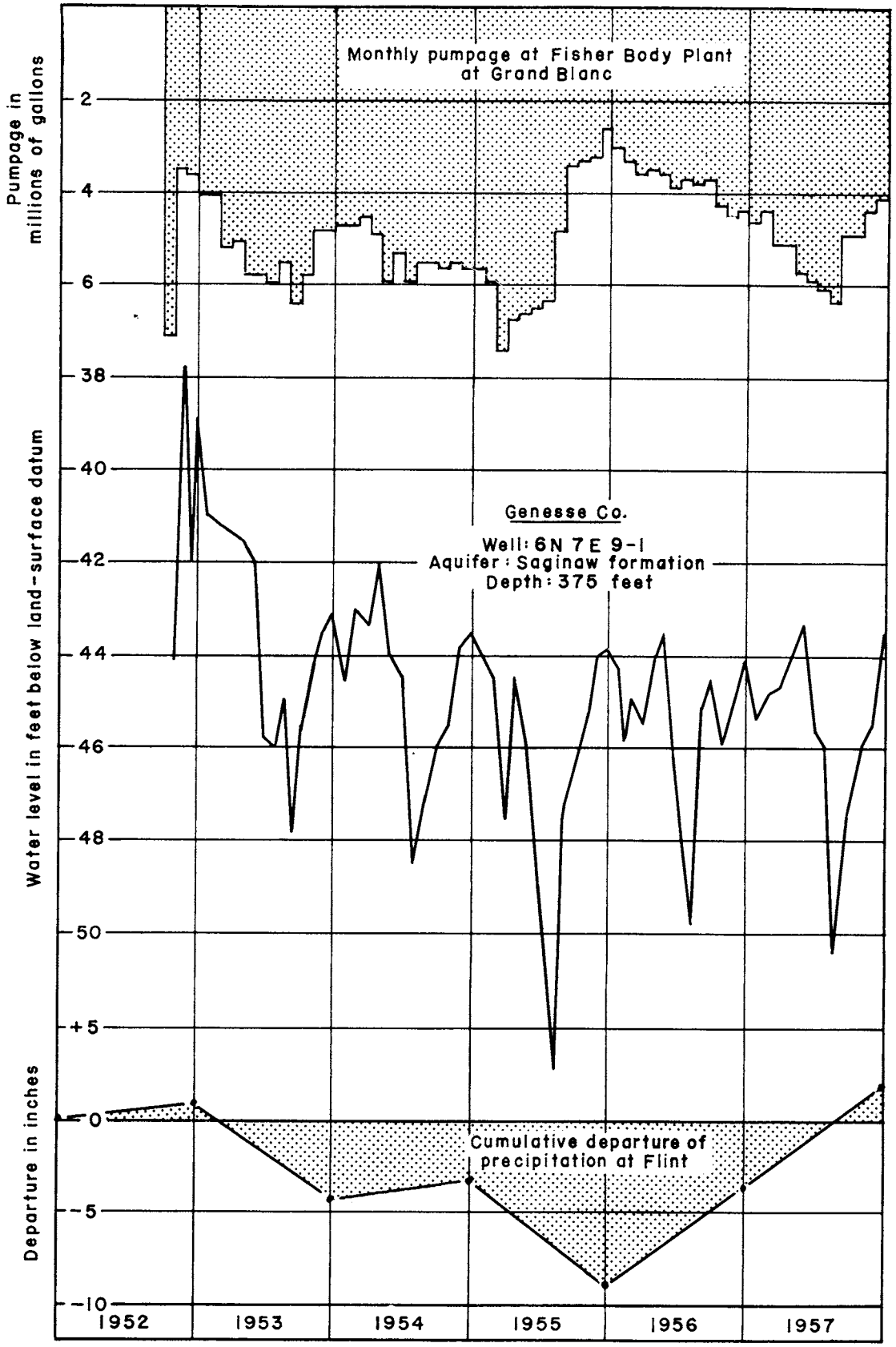


Figure 13.--Hydrograph of well 6N 7E 9-1 near Grand Blanc, monthly pumpage at the Fisher Body Plant, and cumulative departure of precipitation, 1952-57.

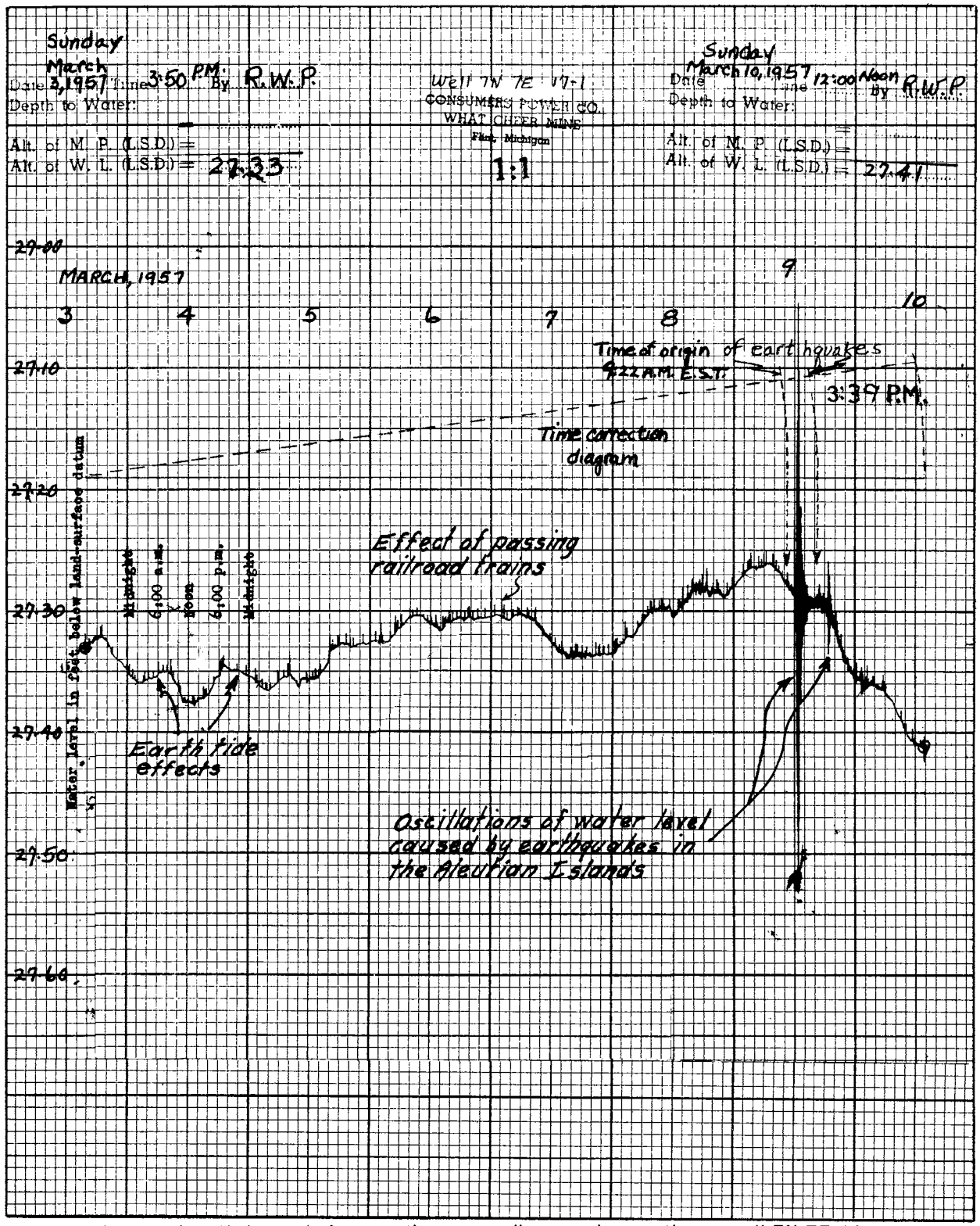


Figure 14. Hydrograph from continous recording gage in operation on well 7N 7E 17-1 at Flint, for week ending March 10, 1957.

Plant at Grand Blanc, for the period of record, 1952-57. Heavy pumping at the plant and a general decline in precipitation culminated in low water levels in the observation well by mid-1955 Since 1955, however, precipitation has increased and the water level in the observation well has remained relatively steady.

Figure 14 is a chart taken from a continuous recording gage on observation well 7N 7E 17-1, finished in the Saginaw formation. This well is unique in that it is the only observation well presently maintained in Michigan which frequently shows fluctuations in water level due to earthquake shocks in many parts of the world and to other forces which may cause elastic deformation of an aquifer. The twice-daily undulations of the water level were caused by earth tides. The short vertical displacements on the graph are fluctuations caused by compression of the aquifer by the weight of passing railroad trains. The pronounced and rapid vertical oscillations of water level (March 9) were the result of seismic compressional waves from earthquakes that occurred at 9:22 a.m. E.S.T., March 9, in the Andreanof Islands and at 3:39 p.m. E.S.T. in the Fox Islands, both in the Aleutian Islands of Alaska. The waves traveling through the earth's crust (an arc distance of about 4,200 statute miles), reached the Flint well in less than an hour. The slight correction of graph time on the chart was necessary to compensate for a minor inaccuracy of the timing mechanism. The effects of earthquakes shown on the graph are typical of many recorded each year by the Flint well.

Gratiot County.--Observation wells in the Alma area are finished in the surficial drift deposits or in deeper, buried sand and gravel outwash.

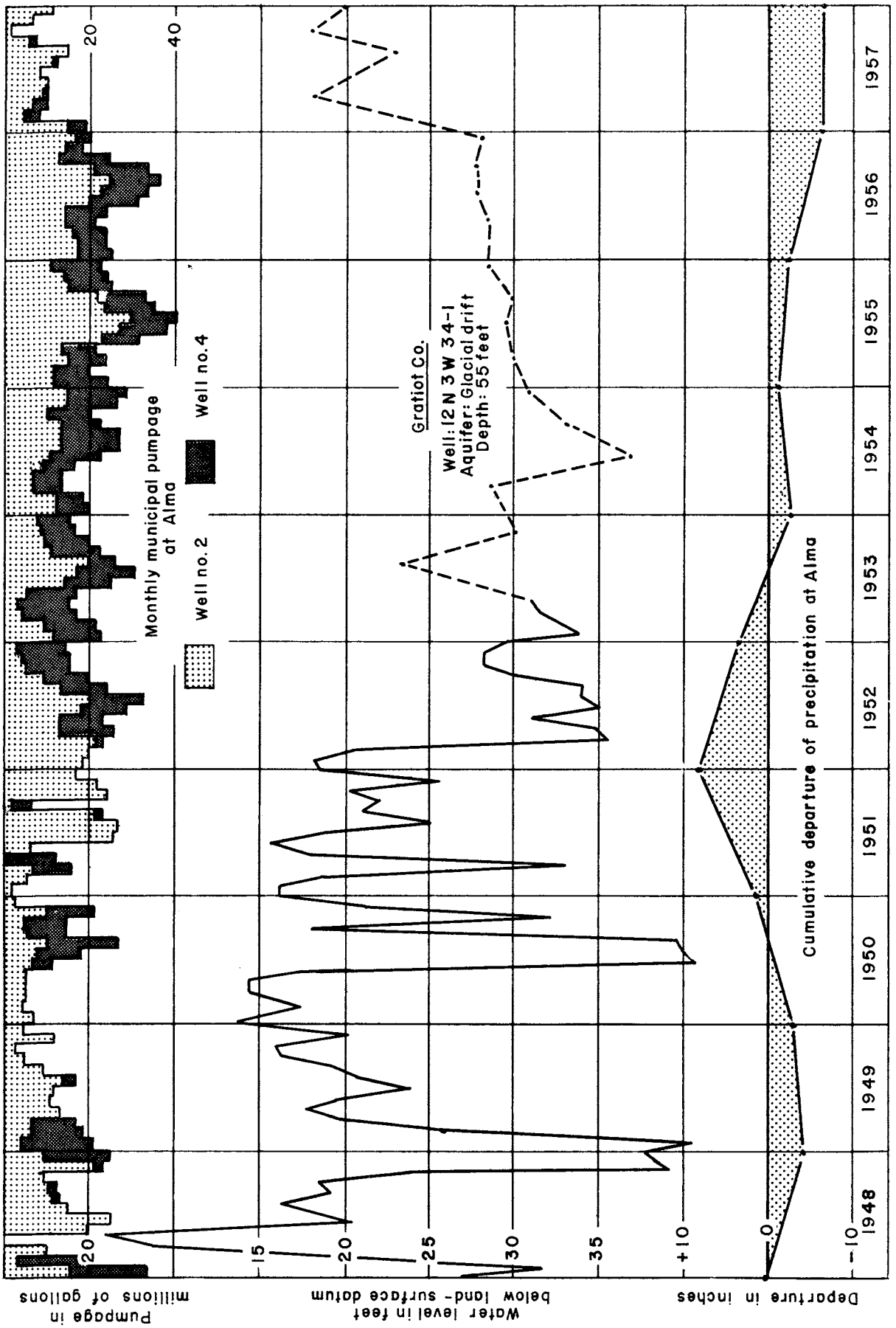


Figure 15.--Hydrograph of well 12N 3W 34-1 at Alma, monthly municipal pumpage from wells 2 and 4, and cumulative departure of precipitation, 1948-57.

Municipal and industrial wells tap the buried outwash. One deep municipal well taps the Saginaw formation. The artesian pressures in the buried outwash are affected by municipal and industrial pumpage but the water level in the surficial drift primarily reflects climatic conditions.

Figure 15 shows the effects of pumping from municipal wells 2 and 4 on observation well 12N 3W 34-1 which is within the cone of influence of the pumping wells. In 1956 and 1957 pumping was decreased in this well field and the center of pumping shifted when new wells on the west side of the city were put into service. As a result the water level in the observation well reached the highest level observed since 1951 despite a cumulative deficiency of precipitation.

Other observation wells in the center of the city also rose due to the changes in pumping pattern mentioned above. Not all of the net gain in water level was due to pumping changes, however, as levels in other observation wells in the area rose in response to favorable conditions for recharge in the fall of the year. Rises in water level ranged from about a foot in some wells in the water-table aquifers to as much as 14 feet in the deeper drift wells.

Municipal withdrawals of ground water totaled 554 million gallons in 1957, which was about 100 million gallons less than was pumped in 1955 and 1956.

Ingham County

Lansing metropolitan area.--The Saginaw formation is the principal source of water for municipal and industrial wells in the area, although a

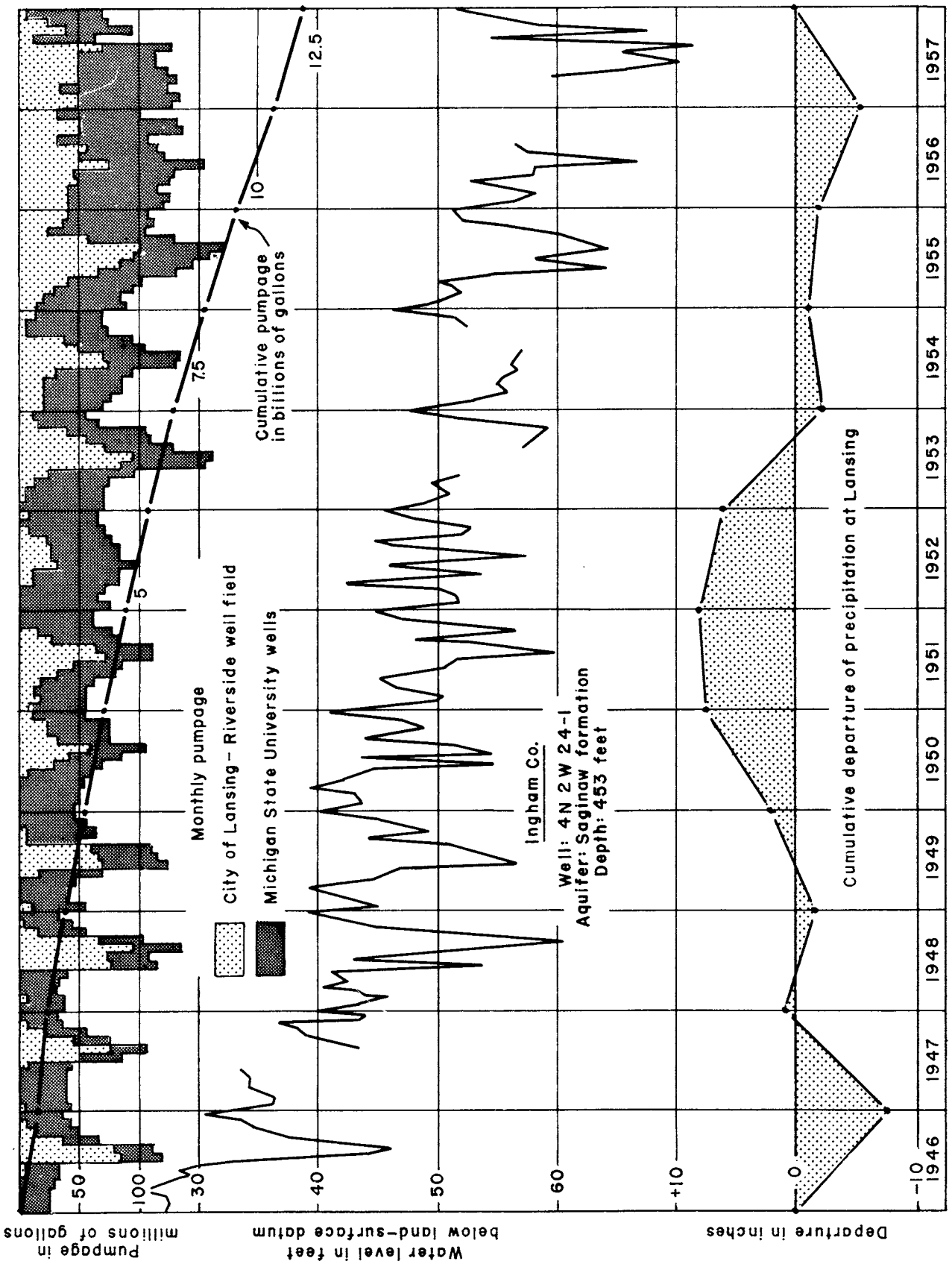


Figure 16.--Hydrograph of well 4N 2W 24-1 at Michigan State University, monthly and cumulative pumpage from nearby well fields, and cumulative departure of precipitation, 1946-57.

few wells obtain water from the overlying glacial drift. The water level in most observation wells finished in the Saginaw formation reflect changes in Rate of withdrawal of ground water from the aquifer, but some reflect only general climatic conditions.

In the City of Lansing water levels in wells on the northwest side of the city continued to rise during 1957 while levels fell in the south-central section as a result of the changes in municipal pumping pattern that began in 1956.

In the spring of the year 1957 the levels in many of the observation wells were the lowest of record as the result of the deficiencies of precipitation of the past few years and especially the large deficiencies in the fall and winter of 1956. During the summer and fall of 1957, however, favorable precipitation and temperature conditions caused levels in most wells to rise to stages above those observed at the end of 1956.

Observation well 4N 1W 18-1, at Marble School in East Lansing, reflects pumping by nearby municipal wells. The water level in this well continued the decline that has persisted since the beginning of record in 1953.

Figure 16 illustrates the effect of precipitation and also pumping from Michigan State University wells and Lansing's Riverside well field on the water level in observation well 4N 2W 24-1, at the University. As shown, above-average rainfall moderates the rate of decline whereas dry periods accelerate the decline of water level in the observation well. The precipitation-departure curve indicates that although there was deviation from average from year to year, total precipitation for the entire

from nearby well fields, and cumulative departure of precipitation, 1946-57.

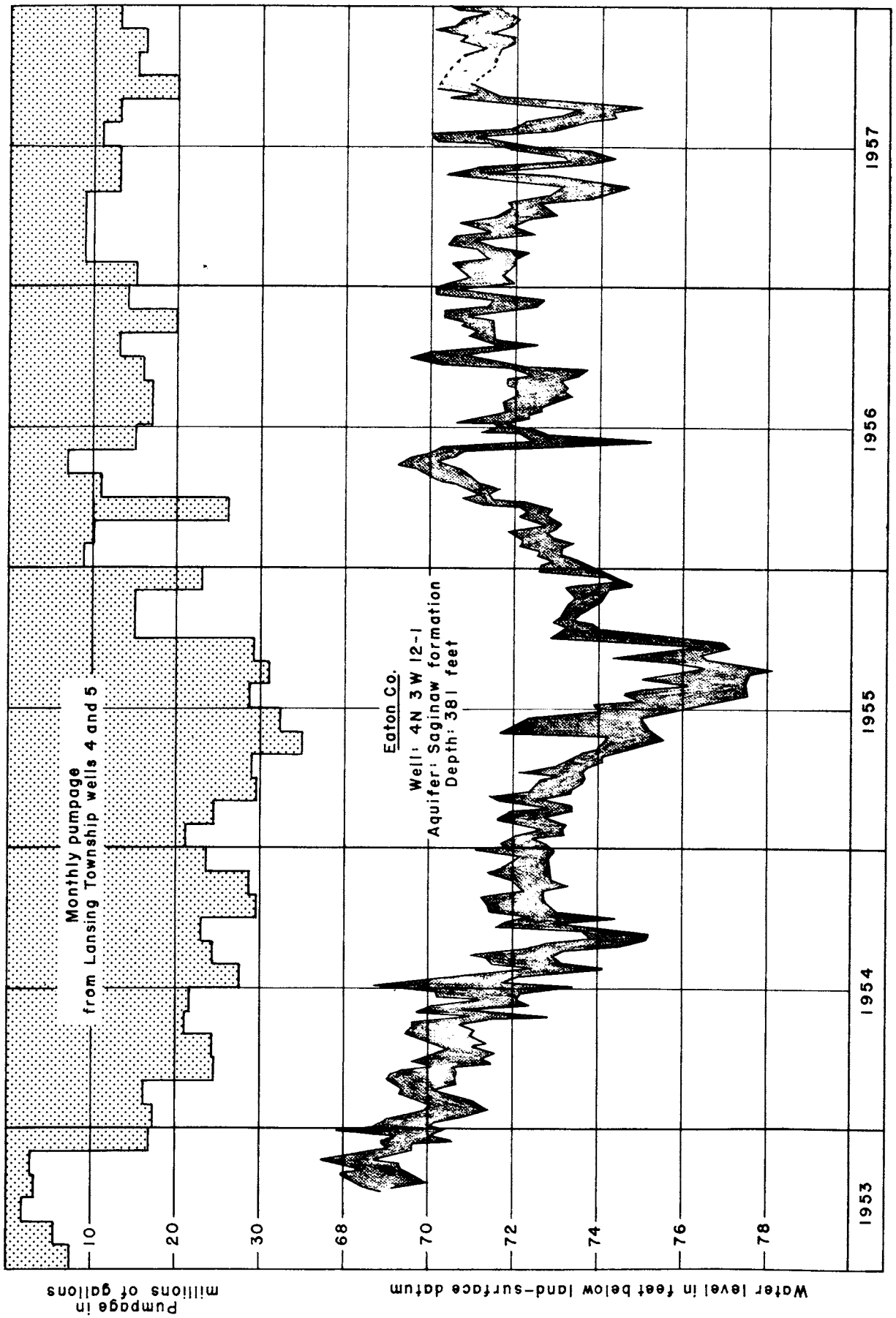


Figure 17.--Hydrograph showing range in water levels in well 4N 3W 12-1 near Lansing, and monthly pumpage from Lansing Township wells 4 and 5, 1953-57.

period was about normal. Thus, the decline in water level during the 11 years of record resulted primarily from pumping in the area. The pumping shown in figure 16 is from wells about 1/2 mile to 1 mile or more from the observation well.

Figure 17 shows the effect of pumping from Lansing Township wells 4 and 5 on the water level in observation well 4N 3W 12-1, which is in Delta Township of Eaton County about 1 mile away. The decreased and relatively steady pumping since 1955 has resulted in apparent equilibrium between recharge available to the well and pumping withdrawals in the area, as the water level has not changed significantly during the past two years.

The average daily withdrawals of ground water for municipal use by Lansing, East Lansing, Lansing Township, Meridian Township, and Michigan State University was about 21.5 million gallons during 1957. The total pumpage of 7.9 billion gallons for the year was less than in 1956 (8.1 billion) and in 1955 (8.4 billion).

City of Mason.--Observation well 2N 1W 5-1 (table 1) in Mason is finished in the Saginaw formation. The water level in the well is affected by withdrawals of ground water by local industry. The municipal water supply is obtained from wells tapping glacial sands and gravels. The level in the observation well was about average during 1957 although the spring rise was less than usual. The level at the end of the year was somewhat above previous years as the result of substantial recharge from precipitation and snowmelt during the latter part of the year. Average daily municipal pumpage from the glacial drift was about 386,000 gallons, a slight increase over 1956. Total municipal pumpage for the year was 141 million gallons.

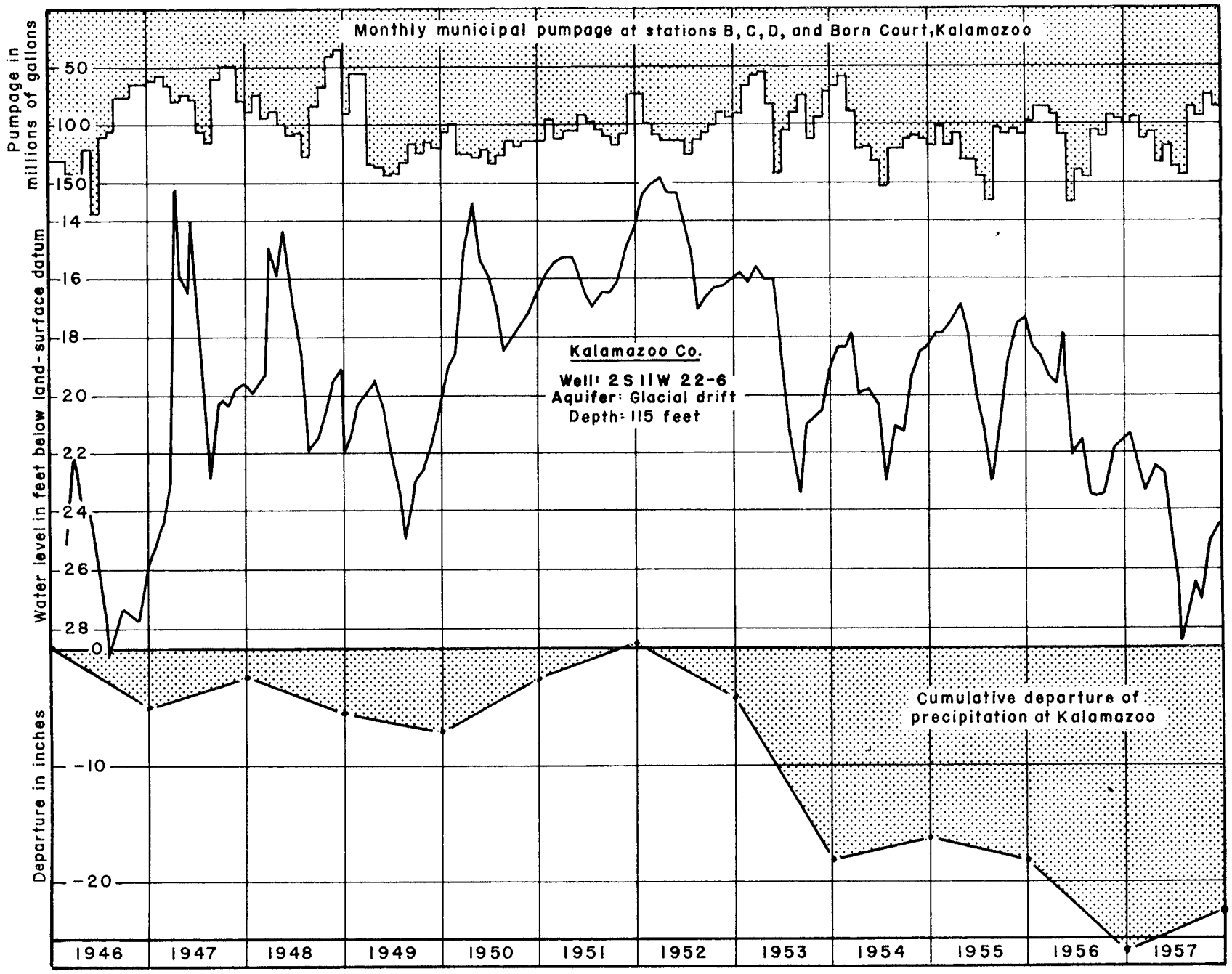


Figure 18.--Hydrograph of well 2S 11W 22-6 at Kalamazoo, nearby municipal pumpage, and cumulative departure of precipitation, 1946-57.

Figure 18.--Hydrograph of well 2S 11W 22-6 at Kalamazoo, nearby municipal pumpage, and cumulative departure of precipitation, 1946-57.

Kalamazoo County.--Wells in the area in and near the City of Kalamazoo tap only glacial-drift aquifers. Stages in many observation wells were considerably below average at the beginning of the year, and fell to the lowest levels observed during the period of record in early fall. In some of the wells, however, water levels were higher at the end of the year as a result of the more than 11 inches of precipitation that fell during the last quarter and the mild temperatures during December that brought recharge from snowmelt. Much of the precipitation that fell during the late spring and summer was evaporated, used consumptively by vegetation or ran off to surface streams. Net rises of water level for the year ranged from .3 to more than 1 foot in observation wells near the Kalamazoo River. In areas affected by heavy pumping or away from the river the levels declined as much as 3 feet. These declines are not to be considered as serious from a water-supply standpoint, as the dewatered portion in most cases is but a small percentage of the total thickness of the aquifer.

Figure 18 shows the effects of municipal withdrawal of ground water from well fields B, C, D, and Born Court, and cumulative departures from average precipitation on the water level in observation well 2S 11W 22-6 at the Burdick Street waterworks plant. It appears from the illustration that long-term trends of water level in this well respond to climatic changes to a greater extent than to the effects of the pumping from the numerous nearby large-capacity municipal wells. It is apparent from inspection of this data that the glacial drift aquifer in this area is a very prolific source of water, inasmuch as large quantities of ground water have been pumped in this vicinity for the past 90 years, with relatively little drawdown of water levels.

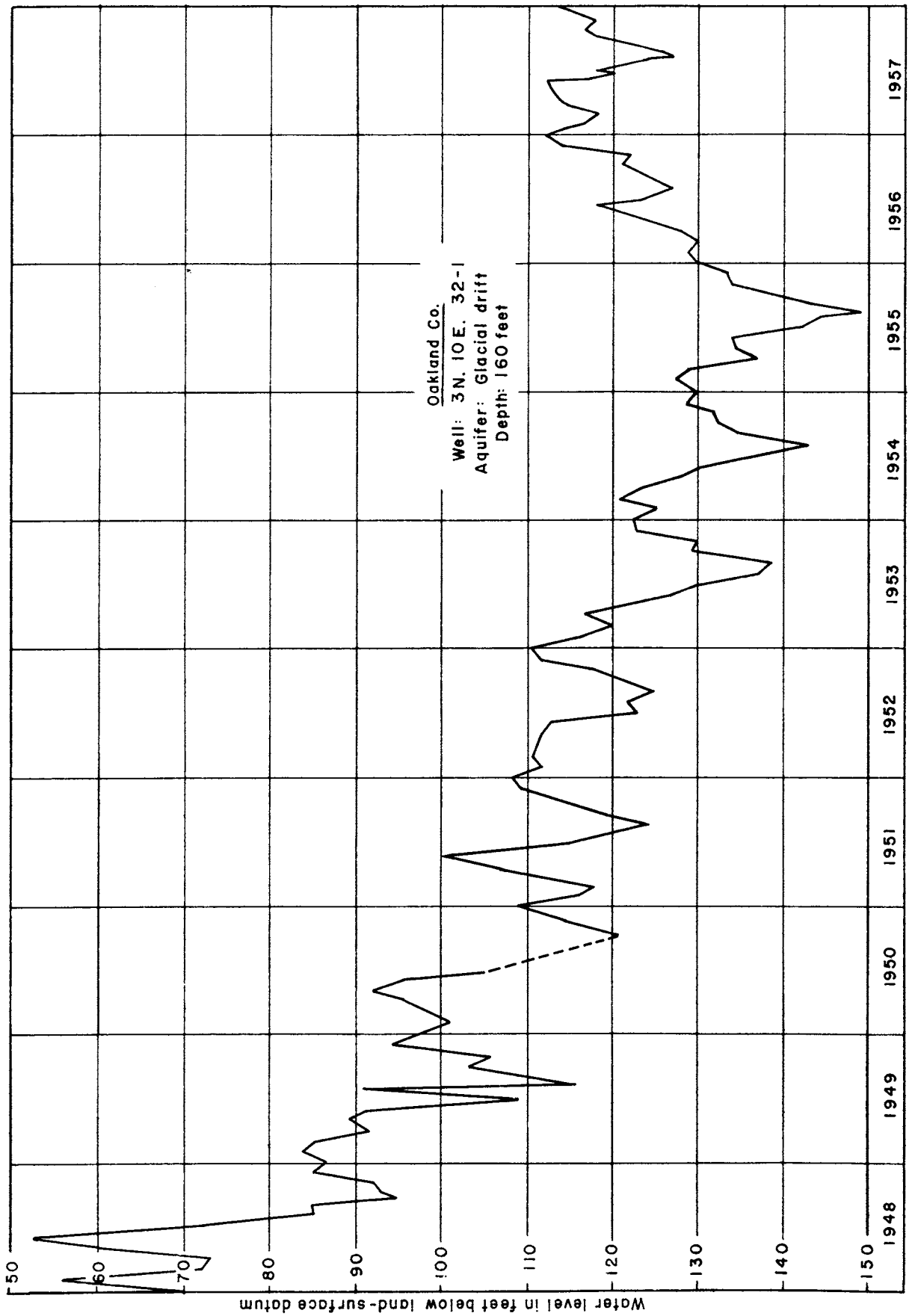


Figure 19.--Hydrograph of well 3N 10E 32-1 at Pontiac, 1948-57.

The total municipal pumpage for the year was a record 4.6 billion gallons, about 10 percent more than in 1956. Pumpage averaged 12.5 million gallons per day (mgd) and ranged from 9.7 mgd in January to 16.4 mgd in August. The large increase in water consumption of the past few years is the result of municipal growth and expansion.

Oakland County.--The observation wells in Pontiac are finished in glacial-drift aquifers as are the municipal and most of the industrial wells in the area. The water levels in observation well 3N 10E 32-1, (fig. 19) and 31-1 were generally higher than in 1956, although there was no net gain for the year. Precipitation in 1957 was more than 4 inches above the long-term mean, but the change in pumping pattern accompanied by decreased pumping in the area adjacent to the two observation wells in Pontiac has been mainly responsible for the reversal of the previous long decline of water level. Municipal withdrawal of ground water from the glacial-drift aquifer in 1957 was 3.3 billion gallons and averaged 9.1 mgd.

St. Joseph County.--Observation well 6N 11W 18-1, on an island at the confluence of the St. Joseph and Rocky Rivers in the City of Three Rivers, is finished in glacial drift and reflects withdrawals of ground water from this aquifer by the city. The water level was somewhat lower in the spring but was higher in the fall than in the corresponding period of 1956. As shown in figure 20, however, the water level in the observation well has not changed significantly during the period of record nor do measurements dating back to 1939 (table 2) show any significant change. Total municipal withdrawal of ground water in 1957 was 218 million gallons, compared to 214 million gallons pumped in 1956.

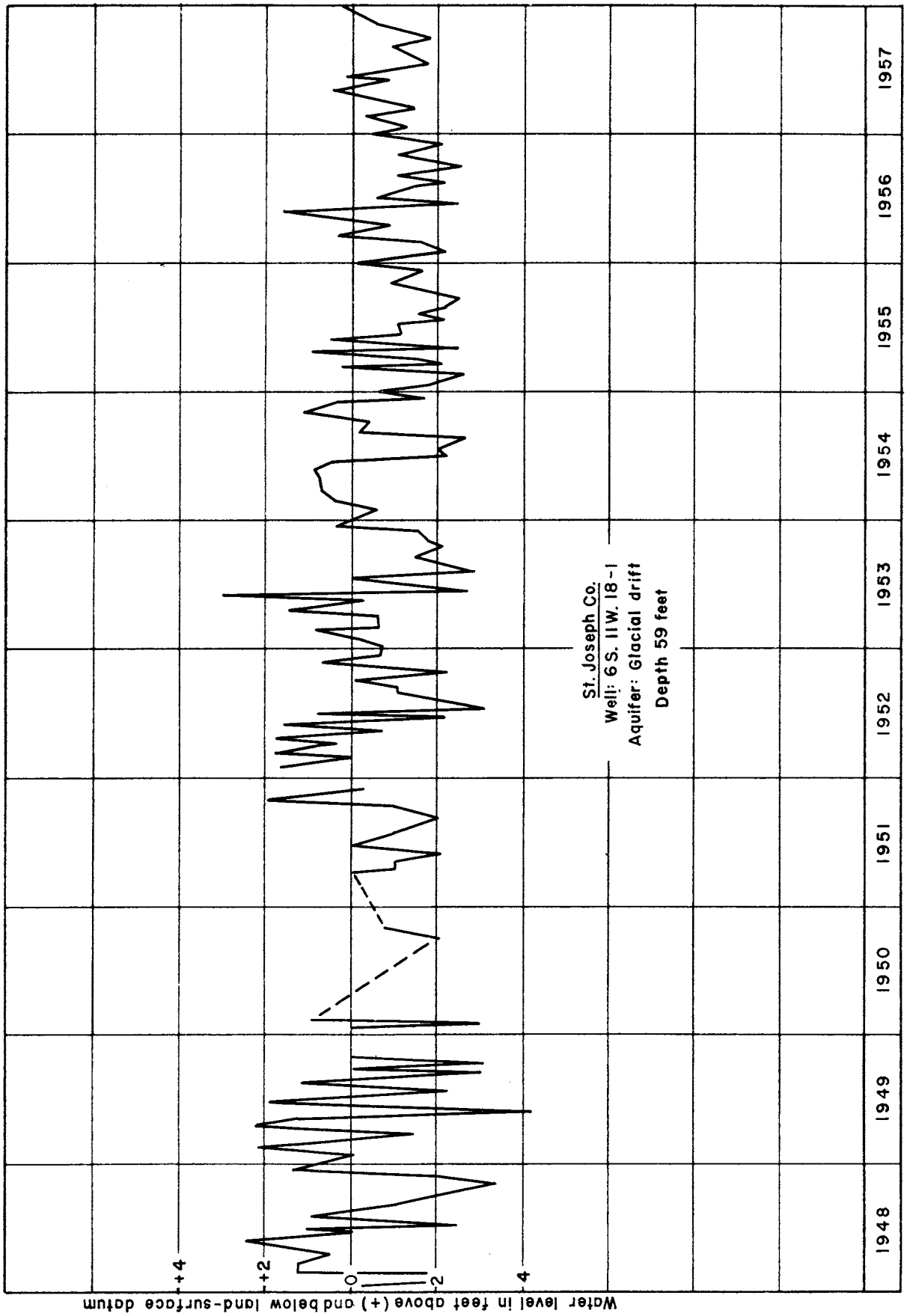


Figure 20.--Hydrograph of well 6S 11W 18-1 at Three Rivers, 1948-57.

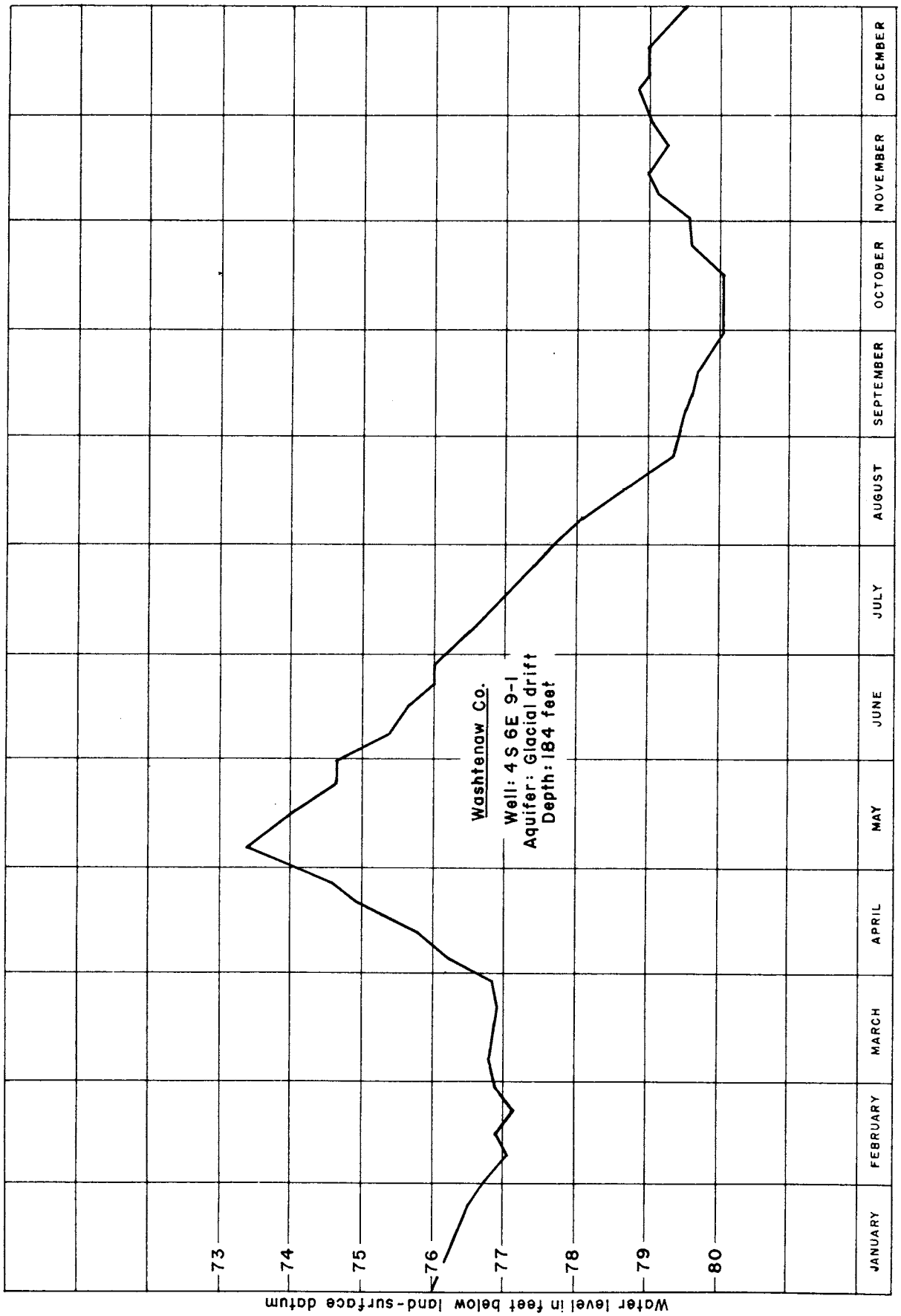


Figure 21.--Hydrograph of well 4S 6E 9-1 at Ypsilanti State Hospital, 1957.

Washtenaw County.--All the observation wells in Washtenaw County are finished in the glacial drift and reflect withdrawals of ground water from drift aquifers by municipal and institutional well fields.

City of Ann Arbor.--The city obtains its water supply from the Huron River and supplements this supply by pumping water from wells south of the city which tap the glacial drift aquifer. The water levels in the two observation wells, at the Steere Farm well field, were generally lower than in 1956, and in well 3S 6E 16-2 reached the lowest stage recorded in the past decade. Monthly pumpage of ground water in 1957 ranged from about 40 million gallons during the late fall and winter to 117 million gallons during the summer.

Ypsilanti State Hospital.--Water levels in the two observation wells at Ypsilanti State Hospital reflect climatic changes and withdrawal of ground water by the institution.

In observation well 4S 6E 9-1 (fig. 21), which is more than a mile from the pumped wells, water levels generally reflected the natural influence of temperature, rainfall, evaporation, and consumptive use by vegetation, rather than pumping. Water levels in the spring were the highest of the past several years partly as the result of rain in April and above-average precipitation for the past two years. The seasonal decline of water level that began in early May continued until mid-October when recharge from above-average autumn rains halted the decline and caused a small rise in water level. In observation well 4S 6E 10-1, which is closer to the pumping wells, levels were generally lower in 1957 as a result of increased pumpage by the State Hospital. Total institutional pumping of 274 million gallons in 1957 was about 9 percent more than in 1956.

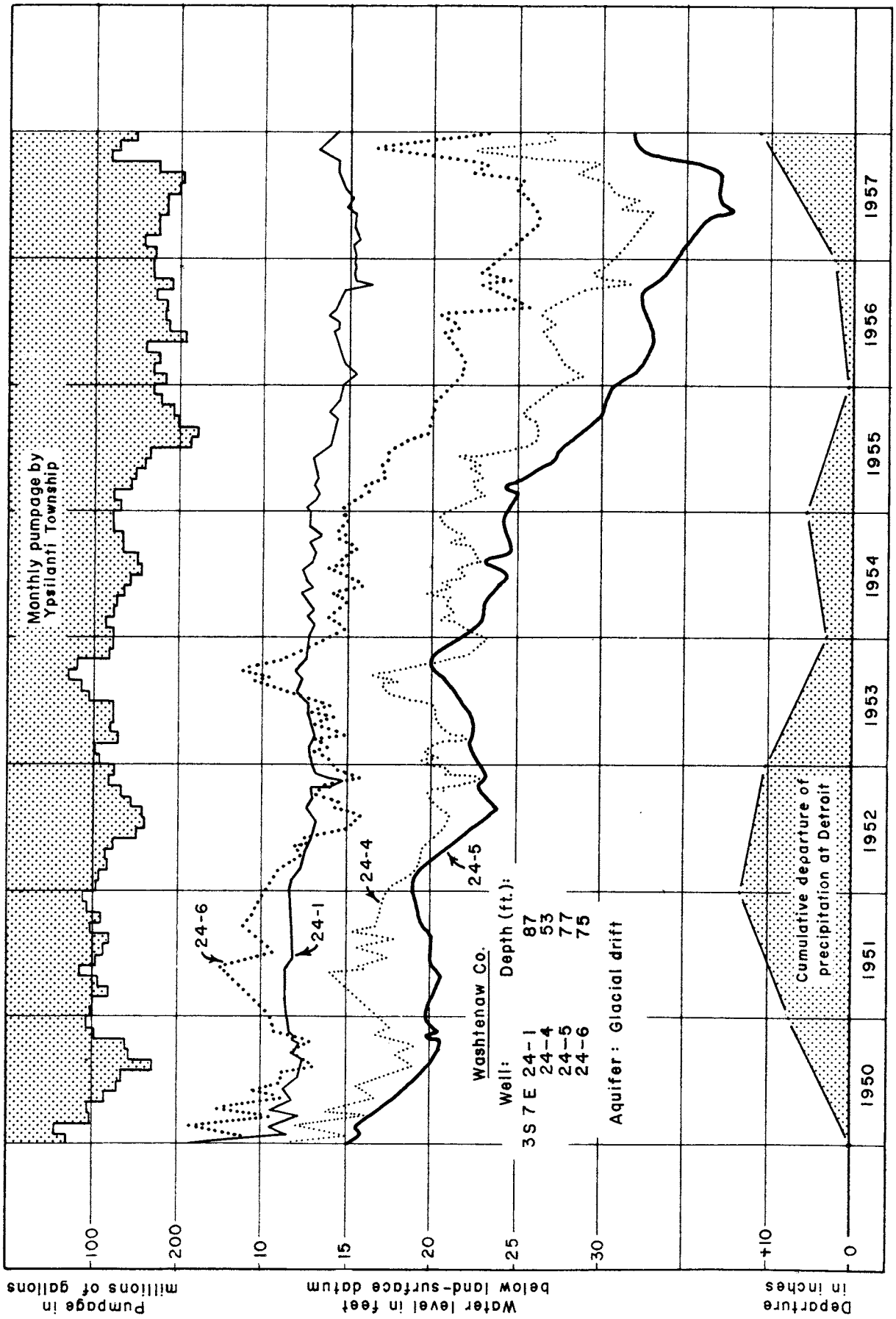


Figure 22.--Hydrographs of 4 observation wells, monthly pumpage by Ypsilanti Township, and cumulative departure of precipitation, 1950-57.

Ypsilanti Township.--Observation wells (fig. 22) at the township well field generally reached new lows of record in May, continuing the decline which had persisted since late 1953, as the result of heavy withdrawals of ground water. Water levels, however, rose several feet by the end of the year as a result of reduced pumping by the township and increased precipitation during the latter part of the year. Well 3S 7E 24-1 is least affected by pumping as it is the farthest from the center of pumping. Total pumpage of about 2 billion gallons was less than in 1956 or 1955. The average daily pumpage from the well field was 5.56 million gallons as compared to 5.91 in 1956.

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.

Owner: Includes owner's designation or field number of well where applicable, (TW - test well);
MDC - Michigan Department of Conservation
WMP - Wisconsin-Michigan Power Company
MSHD - Michigan State Highway Dept.
USFS - United States Forest Service

Chief Aquifer:
Qgd - Glacial deift deposits of Pleistocene (Quaternary) age
IPs - Saginaw formation of Pennsylvanian age
IPp - Parma sandstone of Pennsylvanian age
Mb - Bayport limestone of Mississippian age
Mm - Marshall sandstone of Mississippian age
Dtb - Thunder Bay limestone of Devonian age
Ss - Salina formation of Late Silurian age
Sm - Manistique dolomite of Middle Silurian age
Or - Limestones of Richmond age (Late Ordovician)
Och - Hermansville limestone of Cambrian and Ordovician age
p€ - Rocks or Precambrian age
A - Water confined under artesian conditions
W - Water table conditions

Altitude: Land-surface datum in feet above mean-sea level.

Former USGS No.: See page 8 for explanation of well-numbering systems.

Note: Water-level measurements are made by the U. S. Geological Survey or the Michigan Department of Conservation unless otherwise stated under Remarks

Well number	Location in section ¼	¼	Owner	Depth (ft.)	Diameter (in.)	Chief aquifer	Altitude	Former USGS No.	Remarks
			Alpena County						
32N 6E 16-1	NW	SW	Harlo Mellon	53	6	Dtb A		ApLr 1	
30N 6E 6-1	NW	NE	R. E. James	19	18	Qgd W		ApGn 1	
			Baraga County						
48N 32W 12-1	SE	SE	MSHD (WMP 14)	10	1¼	Qgd W		BgCv 1	Measured by WMP.
			Branch County						
6S 6W 22-1	NE	SW	City of Coldwater (3)	130	8-6	Qgd A		BrCW 3	Measured by owner.
			Calhoun County						
1S 7W 10-1	NW	NW	K. N. Sabin	8	15	Qgd W	907.99	ChPf 102	
31-1	NE	SW	City of Battle Creek (TW 1)	140	2	Mm A	838.92	58	
32-1	NE	SE	Do. (Verona 22)	127	8	Mm A	830.79	1	Measured by owner.
32-2	NE	NW	Mrs. Harriet Rice	43	2	Mm A	842.88	105	
2S 8W 1-1	SW	SE	Sherman Mfg. Co.	22	2	Qgd W	825.19	ChBC 150	
1-2	SW	SE	Electronics Supply Co.	61	2	Mm A	819.08	170	
2-1	NW	SE	Post Products Co.	92	10	Mm A	819.99	160	Measured by City of Battle Creek.
3-1	SE	SE	Dominic Conto	12	2	Qgd W	862.02	ChBc 55	
3-2	SE	NE	Eaton Mfg. Co.	80	10	Mm A	833.39	60	
3-3	NE	SE	P. E. Slayton	64	4	Mm A	849.51	169	
14-1	NE	SE	City of Battle Creek (TW 3)	62	2	Qgd W	916.05	2	
14-2	SE	SE	Do. (TW 1)	89	26	Qgd W	914.97	137	
2S 7W 7-1	SW	NE	Oliver Farm Implement Co.	74	6	Mm A	834.30	ChBC 140	
10-1	NW	SW	C. W. Cronkhite	90	6	Mm A	884.94	ChEm 10	
17-1	NW	SW	City of Battle Creek	87	2	Mm A	841.78	64	
18-1	SW	SW	Do.	87	2	Mm A	832.49	60	
2S 6W 25-1	NE	NE	City of Marshall (Ferguson Well)	59	6	Mm A	904.85	ChMA 2	
25-2	SE	NW	Do. (Egeler Well)	67	6	Mm A	901.15	3	
25-3	SW	SE	Do. (Filkin Well)	82	4	Mm A	914.15	4	
			Cass County						
6S 16W 1-1	SW	NE	City of Dowagiac	159	10	Qgd A	750.19	CsDW 1	Measured by owner.
8S 14W 17-1	NE	NW	Ted Little	55	28	Qgd W		CsMa 1	
			Charlevoix County						
33N 4W 2-1	SW	NE	MDC	94	6	Qgd A		CvCh 1	
32N 4W 10-1	NE	SE	MDC	17	2	Qgd W		CvHu 33	
			Cheboygan County						
34N 1W 1-1	NW	SW	MDC (7)	11	2	Qgd W		CbWk 11	
26-1	SE	NW	MDC (10)	17	2	Qgd W		33	
33N 1W 3-1	SW	SW	MDC (11)	15	2	Qgd W		CbNd 2	

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section ¼	¼	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Cheboygan County - Continued									
33N 1W 10-1	SE	SE	MDC (12)	13	2	Qgd W		CbNd 4	
33N 1E 23-1	NE	SE	MDC (17)	9	2	Qgd W		CbFr 17	
27-1	SE	NE	MDC (16)	15	2	Qgd W		5	
28-1	NE	NW	MDC (7)	14	2	Qgd W		7	
Chippewa County									
46N 4W 24-1	NE	SE	USFS	54	6	Qgd A		CpSp 59	Measured by owner.
Clinton County									
8N 1W 13-1	SW	NW	Village of Elsie	298	12	IPs A	699.68	CtES 1	
13-3	SW	NW	Do. (3)	45	12	Qgd A	706.17	3	
6N 2W 16-1	SE	SE	MSHD	23	14	Qgd W	803.32	CtOe 1	
5N 2W 32-1	SW	SE	Mich. Dept. Health	135	6-4	IPs A	849.21	CtDw 159	
Crawford County									
28N 2W 30-1	NW	SW	MDC (2)	10	2	Qgd W		CrLv 6	
28N 1W 8-1	NE	NE	MDC (6)	13	2	Qgd W		4	
20-1	NE	SW	MDC (18)	13	2	Qgd W		5	
27N 4W 2-1	NE	NW	MDC (42)	13	2	Qgd W	1,194.18	CrFr 1	
19-1	SE	SW	MDC (12)	19	2	Qgd W		5	
23-1	NE	NE	MDC (51)	17	2	Qgd W		2	
27N 3W 15-1	NW	NE	MDC	17	1¼	Qgd W		CrGr 13	
15-2	NE	NW	MDC	13	1¼	Qgd W		14	
27N 1W 4-1	SW	SW	MDC (8)	10	2	Qgd W		CrLv 3	
20-1	SW	SW	MDC (22)	13	2	Qgd W		1	
22-1	NE	NE	MDC (27)	12	2	Qgd W		2	
26N 4W 2-1	SW	SW	MDC (15)	14	2	Qgd W		-	-
5-1	NW	NW	MDC (9)	8	2	Qgd W	1,137.17	CrGr 4	
5-2	NE	SE	MDC (12)	9	1¼	Qgd W	1,144.01	7	
10-1	NE	SE	MDC (10)	12	2	Qgd W	1,146.11	5	
11-1	NW	SW	MDC	12	15	Qgd W	1,147.59	6	
28-1	NE	SW	Michigan National Guard Camp	31	3	Qgd W		11	
26N 3W 8-1	NW	NW	MDC	8	1¼	Qgd W		CrGR 3	
12-1	SE	SE	MDC (28)	16	1¼	Qgd W		CrGr 3	
26N 2W 11-1	SE	SE	MDC (9)	7	2	Qgd W		1	
25N 4W 7-2	NW	SE	H. H. Joseph (8)	137	2	Qgd W		CrBc 32	
8-1	SW	SW	Do. (9)	88	2	Qgd W	1,248.8	31	
21-1	NE	NE	MDC (G3)	53	2	Qgd W	1,229.9	20	
25N 3W 28-1	SW	SW	MDC (8)	13	1¼	Qgd W	1,175.14	1	
25N 1W 15-1	SE	SE	USFS	56	6	Qgd A		CrSb 1	
Dickinson County									
43N 29W 32-1	NW	NE	Dickinson Co. Rd. Comm. (WMP 11)	12	1¼	Qgd W		DkFe 1	Measured by WMP.
42N 27W 33-1	NE	NW	E. W. LaFreniere (WMP 10)	12	36	Qgd W		DkBe 1	Do.
41N 30W 25-1	NE	SW	Dickinson Co. Rd. Comm. (WMP 1)	20	1¼	Qgd W		DkBg 1	Do.
25-2	NW	SE	Wm. Carrolo (WMP 2)	16	36	Qgd W		2	Do.
25-3	SE	NE	Oscar Martinson (WMP 3)	12	48x48	Qgd W		3	Do.
Eaton County									
4N 4W 2-1	SW	SW	City of Grand Ledge	376	12	IPs A	846.59	EaGL 1	Measured by owner.
4N 3W 9-1	SW	SW	B. B. Bosworth	18	48	Qgd W	851.71	EaDt 215	Well destroyed.
10-1	SE	NE	John Schneeberger	121	3	IPs A	855.99	214	
12-1	SE	SW	Mrs. Harold Worden	381	6	IPs A	861.91	30	
24-1	SE	SE	J. R. McLaughlin	22	12	Qgd W	851.96	217	
2N 4W 19-1	NW	SW	City of Charlotte	25	20 ft.	Qgd W	889.44	EaCH 1	
Genesee County									
7N 7E 9-1	SE	SW	Consumers Power Co.	288	12	IPs A	761.83	GeFL 500	
17-1	SE	NE	Do.	222	12	IPs A	757.83	491	
20-2	SW	SW	City of Flint	169	2	Qgd A	749.48	354	
29-1	SE	SW	C. F. Crain	14	1¼	Qgd W	776.63	GeBu 300	
29-2	SW	SE	Clarence Chappell	8	18	Qgd W	779.86	303	
32-1	SW	SW	A. W. Arndt	140	2	Qgd A	792.27	492	
6N 7E 9-1	SW	SE	Grand Blanc Tank Plant (6)	375	6	IPs A	841.71	GeGb 25	Measured by owner.

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section (¼ ¼)	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Gladwin County								
17N 1W 7-1	SW NW	City of Beaverton	93	12	Qgd A	721.50	GwBV 1	Measured by owner.
Grand Traverse County								
27N 9W 4-1	NW NE	MDC (18)	15	2	Qgd W	687.01	GvWw 18	
28-1	SE NW	MDC (15)	17	2	Qgd W	893.26	15	
34-1	SE NW	MDC (25)	18	2	Qgd W	900.25	25	
35-1	SE NW	MDC (1)	17	2	Qgd W	906.11	1	
26N 11W 21-1	SW SW	MDC (14)	13	2	Qgd W	899.26	GvBr 14	
27-1	NW SW	MDC (2)	14	2	Qgd W	914.25	2	
26N 9W 13-1	SW SW	MDC (2)	14	2	Qgd W	961.78	GvUn 2	
25N 11W 2-1	SE NW	MDC (19)	11	2	Qgd W	1,058.81	GvMy 19	
25N 10W 2-1	SW SW	MDC (25)	15	2	Qgd W	945.27	GvPr 25	
8-1	NW NW	MDC (26)	13	2	Qgd W	949.58	26	
25N 9W 23-1	NW SE	MDC (6)	17	2	Qgd W	1,017.85	GvFf 6	
26-1	NW NW	MDC (24)	19	2	Qgd W	1,024.02	24	
34-1	NW NW	MDC (27)	17	2	Qgd W	1,025.34	27	
Gratiot County								
12N 3W 33-1	NE SE	E. E. Peterson	19	1¼	Qgd W	756.10	GrAL 252	
34-1	SW SE	S. J. Brown	55	2	Qgd A	727.12	99	
34-2	SW NE	Vane Mills	13	1¼	Qgd W	747.17	103	
34-3	SW SE	M. J. Patterson	76	2	Qgd A	727.19	255	
34-4	SE NE	Oris Martin	55	2	Qgd A	744.03	358	
34-5	NW NE	City of Alma (5)	90	38-18	Qgd A		5	
35-1	SW SW	A. F. Tennant	14	1¼	Qgd W	747.88	148	
35-2	NE SW	C. H. Gould	14	1¼	Qgd W	739.71	254	
35-3	NW SW	L. A. Halker	26	2	Qgd A	732.62	256	
35-4	NE SW	Calvin Sherwood	28	3	Qgd W	736.1	331	
35-5	SW NW	Reed Excavating Co.	20	36	Qgd W	738.78	360	
12N 2W 18-1	NE NW	Michigan Chemical Co.	1350	5½	Mm A		- -	
11N 3W 2-2	NW NE	Layne Water Co. (2)	130	8	Qgd A	744.15	54	
2-3	NE NW	Bernard Engbloom	11	1¼	Qgd W	749.01	230	
2-4	NW NW	C. D. Peet	15	1¼	Qgd W	750.24	240	
3-2	SW NW	City of Alma (TW 1)	160	8	Qgd A	733.51	73	
3-4	NE NW	Marshall Dallas	49	2	Qgd A	737.48	98	
3-5	NE NE	Thomas Thompson	59	2	Qgd A	743.27	135	
3-6	NW NW	E. H. Waber	49	2	Qgd A	733.20	258	
4-1	SW NE	City of Alma (TW 6)	165	8	Qgd A	732.31	78	
4-2	SW NE	Do. (TW 10)	167	8	Qgd A	734.43	82	
5-1	SE NE	John Pfarr (Alma TW 12)	162	4	Qgd A	740.97	GrAr 33	
36-1	SE SE	Village of Ithaca	785	10-8	Ps, Pp, Mb A	804.50	GrIH 1	
9N 3W 8-1	NE NE	Glenn Corson	31	30	Qgd W		GrPE 1	Well destroyed 1957.
Hillsdale County								
6S 3W 23-2	NW NW	City of Hillsdale (TW 6)	26	6	Qgd W		- -	Measured by owner.
Ingham County								
4N 2W 4-1	NW SW	C and O RR. (East 1)	38	12	Qgd A	842.19	IgLS 33	
7-1	SE NW	Tank Bros.	107	3	Ps A	866.01	IgLs 35	
9-1	SE NW	City of Lansing (Seymour 1)	401	14	Ps A	828.81	IgLS 7	
9-2	SW NW	Consumers Power Co.	370	12	Ps A	820.69	60	
16-1	NE SE	City of Lansing (Cedar)	417	12	Ps A	829.11	9	
17-1	NW NE	Do. (Logan)	424	20	Ps A	858.72	6	
17-2	NW NW	Olds Drop Forge (4)	417	12	Ps A	872.55	51	
19-1	SW SW	Waverly Hills Association	87	2	Ps A	833.94	IgLs 805	
21-1	NE NW	City of Lansing (Townsend)	410	14	Ps A	834.10	IgLS 8	
22-1	SW NW	Do. (P-5)	338	12	Ps A	823.64	3	
22-2	SW NW	Do. (P-9)	218	6	Ps A	830.76	4	
23-1	NE NW	Do. (RS-7)	467	12	Ps A	824.86	5	Measured by owner.
24-1	NE SW	Michigan State University	453	10	Ps A	853.45	IgLs 265	
25-1	NW NE	Do. (Lamb Farm)	120	3	Ps A	866.67	266	
28-1	NE NW	Atlas Drop Forge (2)	425	8	Ps A	849.20	IgLS 182	
31-1	SW SW	C. A. Weber	204	3	Ps A	880.15	IgLs 271	
4N 1W 16-1	NW NE	City of East Lansing (2)	440	12	Ps A	858.8	IgEL 421	Well destroyed 1957.
18-1	SE NE	Marble School	175	3	Ps A	847.85	IgMr 405	

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section ¼	¼	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Ingham County - Continued									
3N 2W 8-1	NW	NW	F. H. Kraus	72	3	IPs A	876.67	IgDh 12	
2N 1W 5-1	SE	SE	City of Mason (old 2)	150	6	IPs A		IgMS 30	Measured by Owner.
Ionia County									
7N 6W 19-1	NE	NE	City of Ionia (8)	143	12	Qgd A		- -	
6N 5W 33-1		NE	Barley-Earhart Co.	15	15 ft.	Qgd W		- -	
Iosco County									
23N 7E 7-1	NE	SE	USFS	341	6	Qgd A		IcWr 1	
Iron County									
46N 34W 14-1	NE	NW	Oliver Iron Mining Co. (WMP 18)	12	1¼	Qgd W		IrHm 5	Measured by WMP.
46N 33W 18-1	SW	NW	MSHD (WMP 17)	12	1¼	Qgd W		4	Do.
45N 37W 23-1	SW	NE	USFS (WMP 28)	8	1¼	Qgd W		IrSt 1	Do.
45N 36W 23-1	NE	NE	USFS (WMP 29)	22	48	Qgd W		IrIr 4	Do.
45N 35W 33-1	SE	NW	MSHD (WMP 34)	12	1¼	Qgd W		IrSt 5	Do.
45N 33W 8-1	SW	SW	Basilio Prandi (WMP 20)	33	36	Qgd W		IrHm 1	Do.
10-1	SE	NW	Bonifas Lumber Co. (WMP 19)	7	1¼	Qgd W		2	Do.
44N 35W 6-1	SW	SW	USFS (Paint River profile 1)	6	1¼	Qgd W	1,468.15	IrIr 5	Do.
6-2	SW	SW	USFS (Paint River profile 2)	13	1¼	Qgd W	1,475.14	6	Do.
6-3	NW	SW	USFS (Paint River profile 3)	12	1¼	Qgd W	1,476.35	7	Do.
7-1	NW	NW	USFS (Paint River profile 4)	4	1¼	Qgd W	1,469.28	8	Do.
7-2	NW	NW	USFS (Paint River profile 5)	13	1¼	Qgd W	1,471.25	9	Do.
7-3	NW	NW	USFS (Paint River profile 6)	17	1¼	Qgd W	1,475.83	10	Do.
44N 33W 10-1	SW	SW	Iron Co. Rd. Comm. (WMP 21)	8	1¼	Qgd W		IrHm 3	Do.
43N 36W 1-1	SW	NE	Do. (WMP 27)	9	1¼	Qgd W		IrIr 4	Do.
1-2	SW	SW	Mr. Williams (16)	50 (?)	?	Qgd W		- -	Mine-drainage study.
43N 35W 11-1	SE	NE	J. J. Javoroski (WMP 23)	47	36	Qgd W		IrIr 1	Measured by WMP.
13-1	SW	SE	F. V. Gendzwill (5)	65	36	pC ?		- -	Mine-drainage study.
13-2	SW	SE	Boyington (hole 4-44)	?	?	? ?		- -	Do.
20-1	SW	SE	Mrs. B. Henriksen (WMP 25)	48	1¼	Qgd W		IrIr 2	Federal Key Well, Measured by WMP.
22-1	SE	NE	Homer Mine No. 6 (2)	?	?	Qgd W		- -	Mine-drainage study.
24-1	SE	NE	Spies - Johnson No. 73 (7)	?	3	Qgd?W?		- -	Do.
26-1	SW	NE	City of Iron River	130	2	Qgd W		- -	Do.
43N 34W 19-1	NW	SW	Spies - Johnson No. 3004 (8)	?	3	Qgd?W?		- -	Do.
19-2	NE	SW	Do. 3c (9)	?	3	Qgd?W?		- -	Do.
29-1	SW	NE	Rogers Mine (11)	?	48	Qgd W		- -	Do.
43N 32W 26-2	NE	SW	Cayia Mine (17)	?	?	Qgd?W?		- -	Mine-drainage study.
42N 36W 15-1	NE	SW	MSHD (Brule River Profile 1)	6	1¼	Qgd W	1,543.92	IrSt 2	Measured by WMP.
15-2	NE	SW	MSHD (Brule River Profile 2)	7	1¼	Qgd W	1,545.60	3	Do.
15-3	NW	SW	W. Young Estate (Brule River Profile 3)	14	1¼	Qgd W	1,554.36	4	Do.
42N 34W 7-1	SW	NE	Zimmerman No. 1 (13)	171	20-12	Qgd W	1,165.32	- -	Mine-drainage study.
42N 31W 33-1	NW	SE	Iron Co. Rd. Comm. (WMP 7)	11	1¼	Qgd W		IrMt 1	
33-2	NW	SE	Joseph Giachino (WMP 8)	12	15	Qgd W		2	
41N 31W 10-1	SW	NE	Iron Co. Rd. Comm. (WMP 5)	17	1¼	Qgd W		3	
Jackson County									
1S 1E 36-9	SE	SE	MDC (9)	9	1¼	Qgd W		- -	
3S 1W 11-2	NE	NE	City of Jackson (4a)	360	6	IPs A		- -	
Kalamazoo County									
2S 11W 3-37	NE	NE	KVP Co. (TW 6)	25	2	Qgd A	766.93	KoPT 6	
3-60	NE	NE	Do. (61)	36	6	Qgd A	763.18	3-60	Measured by owner.
15-18	NE	SE	Consumers Power Co.	64	12	Qgd A	766.17	KoKO 211	
15-31	NW	SW	Wigginton Co.	68	6	Qgd A	781.37	228	
15-33	NE	SW	Columbia Hotel	65	5	Qgd A	769.46	311	
20-7	SW	SE	Western Michigan Univ.	78	8	Qgd A	868.68	KoKo 42	
22-6	NE	SW	City of Kalamazoo	115	6	Qgd A	777.45	KoKO 114	Do.
22-102	NE	SW	Kalamazoo Creamery	61	12	Qgd A	773.19	242	
26-3	NE	NE	Reed Land Co.	41	6	Qgd A	773.71	240	
27-52	NE	NE	Bryant Paper Co. (7)	113	12	Qgd A	802.59	284	Measured by city of Kalamazoo.
29-3	SW	SE	Oakwood, Inc.	47	2	Qgd A	880.72	KoKo 43	
4S 11W 13-1	NW	SE	Lee Paper Co. (6A)	144	12	Qgd A	839.08	KoVB 6	

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section ¼	¼	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Kalamazoo County - Continued									
4S 11W 13-2	NE	SW	Lee Paper Co. (7A)	48	12	Qgd A	838.18	KoVB 7	
21-2	NW	SW	Willis Chamberlain	19	1¼	Qgd W		- -	
27-1	SE	NW	H. H. Chamberlain	19	1¼	Qgd W	854.64	KoSc 5	
Kalkaska County									
28N 5W 35-1	SE	SE	MDC (22)	14	2	Qgd W		KaBk 22	
27N 5W 27-1	NE	SW	MDC (13)	19	2	Qgd W		KaCw 13	
36-1	SE	NW	MDC (100)	16	1¼	Qgd W		100	
Kent County									
9N 12W 22-1	SE	NE	Village of Sparta (3)	90	12	Qgd A (?)		- -	
23-1	SE	NW	Carnation Co. (6)	280	10	Mb? A		- -	
6N 12W 17-1	SE	NE	Jervis Corp. (1)	30	12	Qgd W		KeGV 10	Measured by owner.
17-2	SE	NE	Do.	26	6	Qgd W	606.05	11	Do.
17-3	SE	NE	Do.	21	2	Qgd W	607.38	12	Do.
17-4	SE	NE	Do.	20	1¼	Qgd W	608.26	13	Do.
17-5	SE	NE	Do.	28	2	Qgd W	613.92	14	Do.
Lake County									
17N 13W 3-1	SW	NW	C and O RR. (East Well)	28	10	Qgd W?		- -	
4-1	SE	NE	Do. (West Well)	83	8	Qgd W?		- -	
Mackinac County									
42N 2W 7-1	NE	NE	USFS (Pontchartrain well)	102	6	Sm A		- -	
41N 5W 23-1	SW	NW	MDC (Round Lake Well)	47	6	Ss A		- -	
Marquette County									
49N 30W 22-1	SW	NE	Marquette Co. Rd. Comm. (WMP 13)	17	1¼	Qgd W		MqMc 1	Measured by WMP.
45N 30W 1-1	SW	NW	Arnold Janofski (WMP 4)	31	36	Qgd W		MqRe 1	Do.
44N 26W 28-1	NE	SE	MDC	31	6	Qgd W		MqFr 1	Measured by USFS.
Mason County									
17N 15W 3-1	SE	SW	USFS	32	6	Qgd W	737.37	MaLo 1	
Montcalm County									
9N 8W 10-1	SW	NW	City of Greenville (1)	29	12	Qgd W?		- -	
15-1	SW	NW	Do. (9)	65	12	Qgd A		MmGV 9	Measured by owner.
Montmorency County									
32N 2E 34-1	NW	NE	MDC	24	2	Qgd W		MyMy 1	
31N 2E 11-1	NW	NW	MDC (6)	12	2	Qgd W		MyBr 6	
14-1	SW	SW	MDC (16)	18	2	Qgd W		16	
31N 3E 9-1	NW	NE	MDC	14	2	Qgd W		MyBm 22	
31N 4E 8-1	NE	SW	MDC (1)	14	2	Qgd W		1	
34-1	NE	SW	MDC (23)	13	2	Qgd W		23	
30N 2E 6-1	SW	NW	MDC (1)	11	2	Qgd W		MyBr 8	
30N 4E 26-1	NW	NE	MDC (18)	10	2	Qgd W		MyRs 18	
29N 2E 22-1	SW	SE	MDC	64	6	Qgd A		MyAb 1	
27-1	NW	NW	MDC (32)	10	2	Qgd W		7	
29N 3E 21-1	NW	NE	MDC (32)	14	2	Qgd W		MyLd 6	
29N 4E 5-1	Ctr	SW	MDC	14	2	Qgd W		MyRs 4	
Oakland County									
3N 10E 31-1	NE	SW	City of Pontiac (Orchard Lake)	173	12	Qgd A		OaPT 48	Measured by owner.
32-1	SE	NW	Do. (6)	160	8	Qgd A	921.88	1	Do.
2N 10E 22-1	NE	NW	Cranbrook School (3)	65	6	Qgd A		OaBH 2	Do.
Ogemaw County									
23N 1E 4-1	SE	NE	MDC (15)	21	4	Qgd W		OgFr 15	

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section ¼ ¼	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Ogemaw County - Continued								
23N 1E 17-1	SE NW	MDC (30)	19	4	Qgd W		OgFr 30	
23N 2E 2-1	NE NW	Charles Hudson	7	36x48	Qgd W		OgKa 1	
Otsego County								
29N 3W 29-1	SW SE	MDC (106)	15	2	Qgd W		OsOk 106	
32-1	SE SW	MDC (105)	8	2	Qgd W		105	
Presque Isle County								
33N 2E 18-1	NE NE	MDC (5)	14	2	Qgd W		PrAs 20	
29-1	SW NE	MDC (20)	13	2	Qgd W		13	
30-1	NE SE	MDC (19)	14	2	Qgd W		18	
30-2	SW NW	MDC (18)	14	2	Qgd W		19	
Roscommon County								
24N 3W 3-1	NW NW	MDC (17)	17	1¼	Qgd W	1,168.02	RoGr 17	
24-1	NW NW	MDC (1)	15	2	Qgd W	1,162.42	1	
24N 2W 1-1	NE NE	MDC (88)	14	1¼	Qgd W	1,164.39	RoHg 88	
7-1	NE SE	MDC (107)	13	1¼	Qgd W	1,138.01	107	
19-1	NE SW	MDC (150)	14	2	Qgd W	1,154.17	150	
20-1	NE NW	MDC (1)	14	8	Qgd W	1,145.30	1	Federal Key Well.
21-1	NW NW	MDC (1000)	15	2	Qgd W		1000	
24N 1W 34-1	NE NE	MDC (30)	19	2	Qgd W	1,194.81	RoAs 30	
23N 3W 12-1	NE SE	MDC (75)	14	2	Qgd W		RoMk 75	
25-1	NE SE	MDC (5)	14	2	Qgd W	1,154.29	5	
23N 2W 31-1	NW NW	MDC	13	2	Qgd W	1,153.63	RoHg 7	
23N 1W 3-1	SE SE	MDC (50)	12	2	Qgd W	1,188.95	RoRf 50	
22N 4W 15-1	SE SE	MDC (4)	11	2	Qgd W	1,155.72	RoRo 4	
22N 3W 22-1	SE NE	MDC (7)	14	2	Qgd W	1,170.58	RoDt 7	
34-1	SE SW	MDC (26)	11	2	Qgd W	1,177.82	26	
22N 2W 14-1	NE NW	MDC (9)	12	2	Qgd W	1,201.55	RoBk 9	
17-1	NE NW	MDC (15)	13	2	Qgd W	1,165.46	15	
22N 1W 11-1	NW NW	MDC (5)	14	2	Qgd W		RoRf 5	
21N 4W 4-1	NW SE	MDC (50)	14	2	Qgd W		RoRo 50	
13-1	NE NE	MDC (8)	12	2	Qgd W	1,132.33	8	
21N 3W 2-1	NE NW	MDC (3)	19	2	Qgd W	1,201.40	3	
5-1	NE NW	MDC (15)	15	2	Qgd W	1,147.86	15	
Saginaw County								
9N 3E 16-1	NE NW	August Bauer	72	2	IPs A		SgCH 9	
St. Joseph County								
6S 11W 18-1	SW SE	City of Three Rivers (7)	59	6	Qgd A	790.92	SpTR 1	Measured by owner.
Sanilac County								
12N 13E 33-1	SE SE	MSHD	150	3	Mm A		SaMr 1	
Schoolcraft County								
47N 16W 30-1	NW NW	MDC (Cusino)	57	6	Cch			
45N 13W 16-1	SW SW	U. S. Fish and Wildlife Service	154	4	Or A		SoGe 112	Measured by owner.
Shiawassee County								
5N 2E 16-1	NE SE	A. B. Cobb	26	1½	Qgd W	896.00	ShPR 8	
Washtenaw County								
3S 6E 16-1	SW NW	City of Ann Arbor	23	2	Qgd A	817.43	WaPf 1	Meas. by Owner.
16-2	SE NW	Do.	23	16 ft.	Qgd A		2	Do.
3S 7E 24-1	NE SW	Ford Motor Co. (104)	87	4	Qgd W	665.56	WaYp 8	Meas. by Ypsilanti Twp.
24-2	NE SW	Do. (106)	53	4	Qgd W	664.51	9	Do.
24-4	NE SW	Do. (107)	53	4	Qgd W	664.05	11	Do.
24-5	NW SW	Do. (109)	77	4	Qgd W	665.56	12	Do.
24-6	SW SW	Federal Works Agency (117) (FWA-13)	75	6	Qgd W	657.83	13	Do.

Table 1.--Records of Michigan observation wells in which water-level measurements were made during 1957.--Continued

Well number	Location in section ¼	¼	Owner	Depth (ft.)	Diameter (in.)	Chief Aquifer	Altitude	Former USGS No.	Remarks
Washtenaw County - Continued									
3S 7E 24-7		SW	Ford Motor Co. (124)	90	24	Qgd W	686.5	WaYp 14	Meas. by Ypsilanti Twp.
4S 6E 9-1	NW	NW	Ypsilanti State Hospital (TW 20)	184	6	Qgd A		WaYk 20	Meas. by owner
10-1	SW	NW	Ypsilanti State Hospital (TW 22)	173	6	Qgd A		22	Do.
Wexford County									
24N 10W 22-1	SW	NW	MDC (2)	13	2	Qgd W	974.11	WeGw 2	
26-1	SW	NW	MDC (4)	13	2	Qgd W	979.26	4	
28-1	SE	NE	MDC (3)	18	2	Qgd W	1,005.49	3	
36-1	NW	NW	MDC (42)	12	2	Qgd W	1,004.86	42	
24N 9W 19-1	SW	NW	MDC (38)	11	2	Qgd W	994.16	WeLb 38	
21N 11W 13-1	NW	NE	USFS	62	6	Qgd W		WeHn 1	
21N 9W 4-1	NW	NE	City of Cadillac	277	8-6	Qgd A		WeCD 1	

Table 2.--Extremes in ground-water levels in observation wells in Michigan
(in feet below or above (+) land surface)

F 57 - Frequency of measurement in 1957:

R - Well equipped with recording gage.
D - Daily measurements.
W - Weekly measurements.
M - Monthly measurements.
Q - Quarterly measurements.
SA - Semiannual measurements.
A - Annual measurements. (shown in parentheses)

Note: 1957 measurements that are underscored are new extremes for entire period of record.

Well number	Years of record	Observed water-level extremes								F 57	Remarks
		Through 1956				1957					
		Highest	Date	Lowest	Date	Highest	Date	Lowest	Date		
Alpena County											
32N 6E 16-1	1948-57	5.46	4-15-55	16.67	11-12-48	6.80	4-26	11.03	10-9	Q	
30N 6E 6-1	1948-57	0.90	4-13-52	9.52	12-11-49	3.07	4-26	7.04	10-9	Q	
Baraga County											
48N 32W 12-1	1948-57	4.19	5- 3-51	6.72	3-15-49	4.83	5-30	5.51	2-28	M	
Branch County											
6S 6W 22-1	1949-57	10.08	4- 8-50	16.67	1-15-54	13.58	12-20	16.64	2-8	W	Affected by pumping.
Calhoun County											
1S 7W 10-1	1946-57	0.89	3-28-50	5.90	1-27-54	4.02	5-22	5.33	10-23	W	
31-1	1945-57	+0.08	5-23-50	4.65	9-19-55	4.07	4-18	5.79	10-18	Q	
32-1	1939-57	0.7	4-26-50	12.75	8- 5-55	6.10	2-24	13.04	8-12	D	Do.
32-2	1946-57	8.98	4-25-50	16.00	9-19-55	14.59	4-18	17.11	10-18	Q	
2S 8W 1-1	1946-57	10.49	4-11-47	17.74	8-21-53	14.00	12-26	16.53	8-14	Q	
1-2	1945-57	3.26	4-11-47	11.16	7-27-49	8.88	4-18	11.08	8-14	Q	Do.
2-1	1946-57	4.75	4- 9-47	9.53	9- 4-53	7.48	5-1	9.60	10-15	R	Do.
3-1	1946-57	1.75	4-28-50	8.25	12-19-56	6.47	12-26	7.13	11-12	Q	
3-2	1946-57	13.43	4-25-50	22.78	12-19-56	19.75	12-26	22.68	10-17	Q	Do.
3-3	1945-57	0.26	4-25-50	9.39	8- 2-46	7.05	12-26	9.17	8-14	Q	Do.
14-1	1939-57	9.10	5-31-52	32.76	3-26-41	11.99	8-14	12.62	10-17	Q	Do.
14-2	1945-57	6.22	5-29-50	12.86	10-18-46	8.85	8-14	9.61	10-17	Q	Do.
2S 7W 7-1	1946-57	15.00	4-11-47	23.86	9-19-55	17.39	12-26	23.04	8-14	Q	Do.
10-1	1946-57	11.42	5-29-50	15.54	3- 7-47	15.08	8-15	15.67	4-18	Q	Do.
17-1	1945-57	6.57	4-25-50	11.23	11- 6-53	9.62	12-26	11.15	10-17	Q	Do.
18-1	1945-57	+0.50	4-25-50	3.24	9-21-49	1.05	12-26	2.52	8-14	Q	Do.
2S 6W 25-1	1950-57	5.46	5- 9-50	9.36	9-19-55	8.95	12-26	9.43	10-17	Q	Do.
25-2	1950-51, 56-57	6.50	9-14-50	8.69	10- 3-56	8.28	12-26	9.00	8-14	Q	Do.
25-3	1950-57	19.71	5- 3-50	26.32	12-19-56	24.02	12-26	24.64	8-14	Q	Do.
Cass County											
6S 16W 1-1	1949-57	+4.20	11-30-51	5.97	7-24-53	+3.95	5-17	2.80	6-21	W	Do.
8S 14W 17-1	1945-57	46.20	7-16-50	55.03	3-10-47	50.85	1-6	52.59	12-22	W	
Charlevoix County											
33N 4W 2-1	1948-57	70.85	7-19-52	75.85	4-16-56	73.09	10-8	75.02	4-25	Q	
32N 4W 10-1	1934-41, 48-57	1.19	3-30-38	5.85	10-24-56	4.59	4-25	6.11	10-8	Q	
Cheboygan County											
34N 1W 1-1	1938-41, 48-52, 55-57	2.75	3-28-38	5.55	10-13-55		(4.28, 10-8)			A	
26-1	1935-44, 48-57	3.90	3-28-38	7.45	10-13-55	5.53	7-16	6.99	1-9	Q	
33N 1W 3-1	1935-44, 48-57	3.99	8-12-42	7.63	10-24-56	5.88	12-27	7.84	1-9	Q	
10-1	1935-41, 48-52, 55-57	1.98	3-28-38	7.84	10-13-55		(5.00, 10-8)			A	
33N 1E 23-1	1935-41, 48-52, 55-57	1.89	3-28-38	9.42	10-18-49		(6.50, 10-9)			A	
27-1	1939-44, 48-57	1.72	4-28-54	5.21	10-18-49	1.34	7-16	2.98	1-8	Q	
28-1	1935-41, 48-52, 55-57	0.95	3-28-38	4.51	10-13-55		(3.16, 10-9)			A	
Chippewa County											
46N 4W 24-1	1952-57	22.67	5-21-53	27.77	4-12-56	e22.45	7-25	26.08	4-3	R	e - estimated.

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes: Through 1956 Highest	Date	Lowest	Date	1957 Highest	Date	Lowest	Date	F 57	Remarks
Clinton County											
8N 1W 13-1	1947-57	+3.78	6- 3-50	35.97	9-16-47	22.85	4-29	37.55	10-15	Q	Affected by pumping.
13-3	1947-57	8.3	4- 5-50	26.4	10-11-49	12.55	10-15	19.45	12-30	Q	Do.
6N 2W 16-1	1948-57	14.59	4-19-52	18.53	12-29-53	16.02	7-29	18.26	1-30	M	
5N 2W 32-1	1944-57	42.02	9-14-44	75.82	12-20-56	74.29	12-23	77.62	4-22	Q	
Crawford County											
28N 2W 30-1	1933, 35-37, 43-57	1.33	4-17-47	4.92	10-13-49		(4.91, 10-7)			A	
28N 1W 8-1	1934-57	4.16	4-18-52	8.78	3-10-36		(7.95, 10-7)			A	
20-1	1934-57	3.44	4-18-52	7.04	10-12-55		(5.35, 10-7)			A	
27N 4W 2-1	1934-57	3.84	4-17-47	7.08	3-14-51	6.28	7-17	7.06	10-7	Q	
19-1	1949-57	14.43	5-14-52	17.59	12-14-49		(16.61, 10-10)			A	
23-1	1939-57	10.91	7-11-43	14.49	10-24-56		(14.58, 10-7)			A	
27N 3W 15-1	1948-57	6.95	4-18-52	10.14	10-12-55		(10.25, 10-9)			A	
15-2	1948-57	1.32	4-18-52	4.20	10-12-55		(4.13, 10-9)			A	
27N 1W 4-1	1934-57	2.74	4-18-52	4.77	3-14-51		(4.33, 10-7)			A	
20-1	1934-57	1.55	7-11-43	5.92	10-12-55		(5.35, 10-7)			A	
22-1	1934-57	3.51	4-18-52	6.38	1-27-56	4.66	7-16	5.76	1-8	Q	
26N 4W 2-1	1955-57	7.55	4-18-56	11.08	10-11-55	7.79	7-17	9.10	10-11	Q	
5-1	1934-57	+0.35	6-17-43	4.63	9-25-35		(2.78, 10-11)			A	
5-2	1934-57	2.31	6-17-43	7.21	10-11-55		(5.42, 10-11)			A	
10-1	1934-57	2.04	6-17-43	8.42	10-11-55		(7.24, 10-11)			A	
11-1	1942-57	4.03	6- 1-43	9.83	10- 3-55	6.10	7-9	8.80	9-14	R	
28-1	1949-57	19.42	7- 1-54	22.39	7-23-49	21.43	7-17	22.30	12-28	Q	
26N 3W 8-1	1949-57	2.62	4-18-52	3.44	10-13-49	3.08	7-18	3.16	4-30	Q	
12-1	1935-57	4.04	3-21-38	9.39	2-15-51	8.45	7-16	9.01	12-24	Q	
26N 2W 11-1	1935-57	0.77	6-13-39	2.54	7-23-40		(1.51, 10-7)			A	
25N 4W 7-2	1952-57	62.58	11-10-53	64.66	11- 2-56		(65.52, 10-11)			A	
8-1	1952-57	55.36	11-12-52	57.48	11- 2-56		(58.36, 10-11)			A	
21-1	1953-57	36.72	9- 9-53	38.66	11- 2-56		(39.12, 10-11)			A	
25N 3W 28-1	1934-37, 39-57	8.70	6-15-43	10.85	11-11-49	10.08	7-15	10.85	1-7	Q	
25N 1W 15-1	1948-57	29.44	8- 4-53	35.97	4- 4-51	31.44	9-15	34.09	5-16	R	
Dickinson County											
43N 29W 32-1	1948-57	5.12	4-18-51	dry	10-12-48	7.50	5-1	10.69	9-30	M	
42N 27W 33-1	1945-46, 48-57	3.08	4-29-54	10.75	10- 3-55	4.78	5-1	9.44	8-30	M	
41N 30W 25-1	1948-57	3.51	10-30-51	dry	10- 3-55	4.43	5-1	dry	Jan.	M	
25-2	1945-46, 48-57	2.61	10-30-51	14.40	3-29-56	4.29	5-1	11.69	12-2	M	
25-3	1945-46, 48-57	1.73	7- 6-53	dry	11- -48	3.75	5-1	9.89	2-28	M	
Eaton County											
4N 4W 2-1	1948-57	21.34	5- 5-50	28.79	12- 3-49	23.38	7-29	27.78	3-18	W	Affected by pumping.
4N 3W 9-1	1944-57	5.55	4-26-52	dry	2-23-54		(12.72, 4-22)			A	Well destroyed.
10-1	1944-57	31.28	5-27-48	37.78	2-28-56	36.90	7-29	37.90	4-29	M	
12-1	1953-57	67.51	11-23-53	78.10	8-19-55	69.84	12-1	75.70	8-22	R	Affected by pumping.
24-1	1944-57	0.14	4-24-50	dry	12-12-55	5.84	12-23	dry	10-24	Q	
2N 4W 19-1	1947-57	8.04	4- 7-47	15.77	1- 2-48	14.18	12-26	15.72	10-17	Q	Do.
Genesee County											
7N 7E 9-1	1946-57	17.50	4-11-48	41.11	7- 6-56	23.42	4-25	45.48	7-20	Q	Affected by pumping.
17-1	1946-57	24.23	2-12-50	37.99	8-24-55	26.47	4-5	e31.79	8-22	R	Do. e - estimated.
20-2	1947-57	1.09	4-26-50	9.07	9-15-55	5.10	4-25	6.63	7-20	Q	
29-1	1946-57	1.69	12-22-49	7.62	9-15-55	6.18	4-25	9.90	10-17	Q	Storm sewers installed, water table lowered.
29-2	1946-57	+0.20	6-29-48	5.37	10-17-46	2.90	2-27	8.10	9-29	M	Do.
32-1	1946-57	18.51	6- 2-47	30.35	9-15-55	26.61	7-20	29.59	10-17	Q	
6N 7E 9-1	1952-57	37.79	11-24-52	52.9	8- 3-55	42.6	1-2	52.4	8-26	R	Affected by pumping.
Gladwin County											
17N 1W 7-1	1950-57	28.90	5-14-56	49.35	6-26-50	31.09	11-23	48.00	12-9	D	Affected by pumping.
Grand Traverse County											
27N 9W 4-1	1934-37, 41-44, 48-52, 55-57	0.91	9-20-44	2.54	7-26-35		(1.55, 10-25)			A	

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes: Through 1956 Highest	Date	Lowest	Date	1957 Highest	Date	Lowest	Date	F 57	Remarks
Grand Traverse County - Continued											
27N 9W 28-1	1934-37, 41-44, 48-52, 55-57	12.11	8- 6-43	dry	10-30-56		(dry, 10-25)			A	
34-1	1934-37, 41-44, 48-52, 55-57	13.78	8- 6-43	dry	1- -37		(dry, 10-25)			A	
35-1	1934-37, 41-44, 48-57	11.76	10- 7-53	15.62	9-10-37	14.59	4-30	14.78	12-30	Q	
26N 11W 21-1	1936-37, 41-44, 48-52, 55-57	1.02	10-30-51	3.31	7-31-41		(1.79, 10-25)			A	
27-1	1935-37, 41-44, 48-57	1.32	10-30-51	4.02	8-18-36	2.35	4-30	3.40	10-25	Q	
26N 9W 13-1	1934-37, 41-44, 48-57	4.83	4-14-55	7.87	10-11-49	4.72	7-17	6.77	1-10	Q	
25N 11W 2-1	1935-37, 43-44, 48-57	1.51	4-22-54	6.40	11-14-35	1.01	4-30	5.07	10-25	Q	
25N 10W 2-1	1936-37, 41-44, 48-57	0.29	9- 3-42	1.68	7- 1-37	1.10	4-30	1.54	1-10	Q	
8-1	1934-37, 41-44, 48-52, 55-57	0.22	10-30-51	2.43	8-27-37		(1.27, 10-25)			A	
25N 9W 23-1	1934-37, 41-44, 48-53, 55-57	3.23	5- 8-51	5.37	9-20-44		(3.82, 10-25)			A	
26-1	1934-37, 41-44, 48-53, 55-57	3.96	5- 9-52	7.63	1-24-49		(6.85, 10-25)			A	
34-1	1934-37, 41-44, 48-57	10.86	8- 6-43	14.38	2-22-49	13.78	10-25	14.81	4-30	Q	
Gratiot County											
12N 3W 33-1	1947-57	8.88	6-10-47	13.63	11-28-49	11.64	12-30	12.80	10-15	Q	
34-1	1947-57	6.08	4-26-48	40.87	6-28-50	18.11	10-15	23.08	8-13	Q	Affected by pumping.
34-2	1946-52, 54-56	4.47	3-23-48	9.39	8-23-46	-	-	-	-	-	Not measured in 1957.
34-3	1946-52, 54-57	5.17	4-26-48	31.05	6-28-50	16.78	4-17	21.97	8-13	Q	Affected by pumping.
34-4	1950-57	21.41	4-28-50	dry	2- -50	23.94	12-30	25.85	8-13	Q	Do.
34-5	1944, 47-50, 55-57	19.94	5- 6-50	42.73	9-15-48	23.17	12-30	25.03	8-13	Q	Do.
35-1	1947-52, 54-56	10.60	5-17-48	12.95	9-26-56	-	-	-	-	-	Not measured in 1957.
35-2	1947-52, 54-57	4.72	6-10-47	11.98	12-22-54		(12.10, 10-15)			A	
35-3	1947-57	10.07	5- 3-48	21.64	6-24-52	16.17	12-30	19.28	8-13	Q	Affected by pumping.
35-4	1950-52, 54-57	4.36	4-27-51	9.56	9-26-56		(9.54, 10-15)			A	
35-5	1950-57	13.74	4- 7-50	17.91	11-12-53	15.77	12-30	16.87	10-15	Q	
12N 2W 18-1	1957	-	-	-	-	260.4	12-31	267.7	8-30	R	Meas. started 8-30-57. Affected by recharging well. (?)
11N 3W 2-2	1947-57	25.0	4-29-48	72.5	8-26-50	57 48	12-30	63.76	8-13	Q	Affected by pumping.
2-3	1946-52, 54-57	5.00	3-23-48	9.16	11-28-49		(8.24, 10-15)			A	
2-4	1947-57	7.69	6-10-47	11.37	11-28-49	9.89	8-13	10.70	4-17	Q	
3-1	1946-56	20.45	11- 6-47	67.62	8-14-53	-	-	-	-	Q	Measurement discontinued
3-2	1955-57	32.26	6-14-55	73.55	12-17-56	18.70	12-30	58.42	10-15	Q	Affected by pumping.
3-4	1956-52, 54-57	16.76	4-12-48	33.22	7-26-51		(27.30, 10-15)			A	Do.
3-5	1947-57	24.35	4-26-48	45.79	9-14-55	38.10	12-30	40.89	8-13	Q	Do.
3-6	1946-57	7.64	2-27-51	32.98	12-16-55	18.11	12-30	29.07	10-15	Q	Do.
4-1	1955-57	12.06	6-14-55	18.58	9-26-56	14.27	12-30	21.38	10-15	Q	Do.
4-2	1955-57	9.24	6-14-55	48.48	9-26-56	43.37	10-15	53.49	8-13	Q	Do.
5-1	1955-57	11.01	7-10-56	13.46	9-26-56	12.50	12-30	16.45	8-13	Q	Do.
36-1	1947-57	78.25	1-22-52	83.96	9- 4-49	79.55	12-30	80.79	8-13	Q	
9N 3W 8-1	1947-57	1.82	1-17-52	21.23	12-16-49	7.70	4-17	12.57	8-13	Q	Well destroyed 10-57.
Hillsdale County											
6S 3W 23-2	1957	-	-	-	-	2.24	4-12	12.96	9-18	W	Affected by pumping. Meas. started 4-12-57.
Ingham County											
4N 2W 4-1	1953-57	25.98	3- 3-53	31.51	12-12-56	30.15	5-26	32.75	11-10	R	Affected by pumping.
7-1	1944-57	53.94	11- 2-44	78.31	11-30-56	78.52	1-30	80.15	9-26	M	Do.
9-1	1919, 1929-57	15.63	3-26-31	154.77	4-10-56	137.17	12-23	146.68	4-22	Q	Do.
9-2	1945-57	61.26	3-23-46	143.27	12-12-55	127.38	12-23	135.17	4-22	Q	Do.
16-1	1945-57	42.01	3-11-46	67.0	8-22-49	57.29	7-29	63.01	4-22	Q	Do.
17-1	1929, 31, 33-57	34.34	12- -29	149.64	4-11-56	137.99	12-23	143.12	4-22	Q	Do.
17-2	1946-57	104.86	12-10-46	148.47	4-10-56	138.54	12-23	145.96	4-22	Q	Do.
19-1	1947-57	0.00	3-29-50	4.68	12-20-56	3.12	10-24	5.08	4-22	Q	

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes: Through 1956 Highest	Through 1956 Date	Through 1956 Lowest	Through 1956 Date	1957 Highest	1957 Date	1957 Lowest	1957 Date	F 57	Remarks
Ingham County - Continued											
4N 2W 21-1	1906, 19, 1929-57	2.0	5- 9-06	61.26	4-11-56	61.50	4-22	63.64	7-30	Q	Affected by pumping.
22-1	1930-57	7.1	7- -32	50.86	12-21-56	42.57	4-22	53.05	12-23	Q	Do.
22-2	1930-57	12.65	7- -32	60.73	9- 2-55		(52.76, 4-22)			A	Measurement discontinued
23-1	1930-32, 36-57	7.55	11-17-30	105.28	7-17-56	62.28	12-31	91.28	8-30	M	Affected by pumping.
24-1	1945-57	25.47	3-25-46	67.10	6-14-56	e51.1	12-25	71.7	8-16	R	Do.
											Meas. resumed 4-29-57
											e - estimated.
25-1	1944-50, 55-56	21.60	3-30-46	39.06	10-31-56	-	-	-	-	M	Measurement discontinued
28-1	1944-45, 48-57	30.28	4-23-48	54.40	8-19-48	46.39	10-24	47.82	4-22	Q	Affected by pumping.
31-1	1944-57	18.92	4-26-52	24.77	2- 2-54	22.77	5-29	24.73	1-30	M	
4N 1W 16-1	1953-57	50.20	12-15-53	58.07	12- 5-56		(56.18, 4-1)			A	Do.
											Well destroyed, 5-57
18-1	1952-57	20.09	4-27-53	28.56	12-21-56	25.15	10-24	29.64	4-24	Q	Affected by pumping.
3N 2W 8-1	1950-57	10.43	5- 1-50	15.22	11-24-53	13.48	7-30	14.55	4-22	Q	
2N 1W 5-1	1948-57	0.08	6-29-49	7.37	9-17-55	1.88	12-21	6.61	10-5	W	Do.
Ionia County											
7N 6W 19-1	1957	-	-	-	-	46.77	11-18	49.27	11-9	R	Affected by pumping.
											Meas. started 9-10-57.
6N 5W 33-1	1957	-	-	-	-	8.32	12-19	10.02	10-7	R	Meas. started 9-10-57.
Iosco County											
23N 7E 7-1	1948-57	25.13	8- 3-52	27.94	1- 3-50	26.17	1-7	27.02	10-10	Q	
Iron County											
46N 34W 14-1	1945-57	3.65	6- 2-54	8.60	3-15-49	5.81	5-1	7.73	8-30	M	
46N 33W 18-1	1948-57	2.80	4-18-49	dry	2-28-56	5.21	5-1	7.84	8-30	M	
45N 37W 23-1	1948-57	0.75	8-31-51	4.72	9-11-48	1.36	5-1	3.41	8-30	M	
45N 36W 23-1	1945-46, 48-57	5.71	5-31-56	23.21	5-16-49	6.15	3-28	17.30	1-4	M	Meas. discontinued 4/57
45N 35W 33-1	1948-57	1.93	7- 6-53	8.44	3-15-49	4.80	5-1	6.16	12-2	M	
45N 33W 8-1	1945-57	23.39	10-30-51	32.16	3-15-49	27.52	5-1	28.67	12-2	M	
10-1	1948-57	2.01	9-28-51	4.23	3-12-49	2.78	5-1	3.79	8-30	M	
44N 35W 6-1	1948-57	+0.10	5- 2-51	2.26	11-15-48	1.44	3-28	2.26	9-1	M	
6-2	1948-57	5.08	7- 6-53	8.92	11-15-48	7.42	5-1	8.83	9-1	M	
6-3	1948-57	4.03	7- 6-53	9.20	11-15-48	7.26	5-1	8.95	9-1	M	
7-1	1948-57	1.12	5- 2-51	3.51	9-14-49	2.50	3-28	3.73	8-1	M	
7-2	1948-57	2.50	7- 6-53	9.44	10-26-48	4.32	5-1	5.52	9-1	M	
7-3	1948-57	8.48	5- 2-51	13.40	10-26-48	11.56	5-1	13.07	9-1	M	
44N 33W 10-1	1948-57	1.95	4-29-54	7.94	1-12-51	3.31	3-28	7.44	8-30	M	
43N 36W 1-1	1948-57	6.67	4-29-54	9.02	6-30-52	7.97	5-1	8.49	2-28	M	
1-2	1945-57	42.17	4-11-52	48.68	11-23-48		(45.20, 9-18)			A	
43N 35W 11-1	1945-57	39.33	1-11-52	47.08	8-15-49	42.87	1-4	43.48	7-1	M	
13-1	1945-57	47.90	9-11-46	63.68	11-30-46	53.59	3-20	54.20	9-18	SA	
13-2	1945, 47 - 57	66.39	1-14-52	71.56	3-24-49	68.83	3-20	69.26	9-18	SA	
20-1	1945-57	41.66	6-20-53	48.29	8-15-49	44.83	1-4	45.33	12-2	M	
22-1	1945, 47-57	118.82	9-16-53	132.37	1-19-49		(130.03, 3-20)			A	Measurement discontinued
24-1	1945-57	70.42	11-20-56	86.05	1-19-49	70.66	9-18	70.76	3-20	SA	
26-1	1945-57	25.30	9-24-45	44.58	3-24-50	29.67	9-18	30.57	3-20	SA	
43N 34W 19-1	1945-57	63.37	12-20-56	89.5	10-20-45	68.56	9-18	68.70	3-20	SA	
19-2	1945-57	69.35	12-20-56	84.10	12-21-48	74.50	3-20	74.68	9-18	SA	
29-1	1947-53, 57	10.31	8-15-53	20.69	3-24-50	15.80	3-20	16.42	9-18	SA	
43N 32W 26-2	1952-57	1.04	5-12-55	86.03	3-18-53	10.58	9-18	11.20	3-20	SA	
42N 36W 15-1	1948-57	0.81	4-29-54	3.17	10-26-48	1.83	2-28	3.06	8-1	M	
15-2	1948-57	0.46	7- 6-53	3.10	10-26-48	1.37	5-1	2.72	8-1	M	
15-3	1948-57	3.67	4-29-54	8.29	10-26-48	5.87	5-1	7.64	9-1	M	
42N 34W 7-1	1945-57	132.24	8-23-56	153.27	4-21-50	133.77	3-20	134.47	9-18	SA	
42N 31W 33-1	1948-57	+0.03	7- 3-56	6.28	10-13-48	0.32	5-1	4.10	2-28	M	
33-2	1945-57	1.89	10-30-51	12.22	2-25-53	5.90	5-30	10.56	12-2	M	
41N 31W 10-1	1948-57	8.47	1- 3-52	dry	12-15-48	12.39	7-1	14.74	2-28	M	
Jackson County											
1S 1E 36-9	1956-57	0.42	5-10-56	5.75	11-16-56	0.95	4-5	4.10	8-31	W	Meas. started 2-29-56.
3S 1W 11-2	1957	-	-	-	-	21.1	7-7	71.5	8-14	D	Affected by pumping.
											Meas. started 6-13-57.
Kalamazoo County											
2S 11W 3-37	1946-57	9.49	4-18-50	14.90	10- 4-56	13.48	12-26	14.96	10-18	Q	Affected by pumping.
3-60	1956-57	10.48	7-17-56	12.04	10-15-56	10.21	5-27	12.05	10-14	W	Do.
15-18	1946-57	9.20	3-28-50	15.40	8-23-56	14.35	12-26	15.97	10-18	Q	Do.

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes: Through 1956 Highest	Date	Lowest	Date	1957 Highest	Date	Lowest	Date	F 57	Remarks
Kalamazoo County - Continued											
2S 11W 15-31	1946-57	18.55	5-22-50	25.85	2-24-54	25.55	12-27	26.05	10-18	Q	Affected by pumping.
15-33	1946-57	13.64	4-18-50	20.95	2-24-54	20.18	12-27	21.51	10-18	Q	Do.
20-7	1946-57	33.44	6-19-50	36.43	12- 5-46	36.31	4-18	36.90	10-18	Q	
22-6	1946-57	11.22	3-11-52	29.36	8- 9-46	21.09	1-25	28.24	8-24	R	Do.
22-102	1946-56	13.98	5- 3-50	27.42	12- 5-46	-	-	-	-	Q	Do. Meas. discontinued
26-3	1947-57	3.63	4-26-50	11.14	11- 6-53	8.20	12-26	9.36	8-15	Q	Affected by pumping.
27-52	1946-57	34.46	5- 5-50	64.37	9- 1-46	42.93	1-21	46.35	8-23	R	Do.
29-3	1946-57	26.12	8- 1-52	29.88	8- 6-53	29.35	4-19	29.77	10-18	Q	
4S 11W 13-1	1946-56	+2.08	4- 7-47	10.15	9- 9-46	-	-	-	-	W	Not measured in 1957.
13-2	1946-56	+0.55	7- 8-50	9.72	9-14-46	-	-	-	-	W	Do.
21-2	1957	-	-	-	-	14.07	12-28	14.62	11-14	W	Meas. started 11-7-57.
27-1	1953-57	12.94	7-12-56	15.22	1-20-54	13.72	5-2	14.99	10-10	W	
Kalkaska County											
28N 5W 35-1	1949-57	8.62	4-16-53	11.77	12-14-49	10.38	7-17	11.38	1-9	Q	
27N 5W 27-1	1942-57	12.50	7-11-43	17.22	1-23-50		(15.95, 10-11)			A	
36-1	1939-57	11.12	7-11-43	14.69	3-12-40	12.80	7-17	14.43	1-9	Q	
Kent County											
9N 12W 22-1	1957	-	-	-	-	35.60	9-6	44.3	10-29	W	Affected by pumping. Meas. started 9-6-57.
23-1	1957	-	-	-	-	0.13	12-28	7.9	10-6	R	Do.
6N 12W 17-1	1950-57	6.88	6- 8-56	16.45	2-12-54	10.43	12-27	14.05	2-1	W	Affected by pumping. Do.
17-2	1950-57	7.34	6- 1-56	16.32	2-12-54	10.36	12-27	13.91	1-18	W	Do.
17-3	1950-57	7.14	6- 1-56	15.87	2-12-54	10.14	7-26	13.54	1-18	W	Do.
17-4	1950-57	7.80	6- 1-56	16.81	2-12-54	10.89	7-26	14.40	2-1	W	Do.
17-5	1950-57	13.30	6- 1-56	22.22	2-12-54	16.27	6-5	19.79	2-1	W	Do.
Lake County											
17N 13W 3-1	1957	-	-	-	-	19.94	7-18	21.28	12-31	Q	Meas. started 7-18-57.
4-1	1957	-	-	-	-	19.34	7-18	20.34	11-4	Q	Do.
Mackinac County											
42N 2W 7-1	1956-57	16.56	7-15-56	28.0	10-25-56	15.15	7-5	29.35	11-5	R	
41N 5W 23-1	1956-57	13.93	12-14-56	15.51	11-15-56	5.80	4-13	17.09	11-8	R	
Marquette County											
49N 30W 22-1	1948-57	0.64	5- 3-51	13.32	9- 2-48	8.31	5-1	11.24	8-30	M	
45N 30W 1-1	1945-57	24.38	12-13-56	29.28	3-15-49	26.11	1-4	27.08	12-2	M	
44N 26W 28-1	1953-57	2.05	5-10-54	2.64	8-30-55	2.22	4-30	2.83	8-30	M	
Mason County											
17N 15W 3-1	1948-57	14.44	5-15-52	18.50	3- 1-51	18.01	7-18	19.30	12-31	Q	
Montcalm County											
9N 8W 10-1	1957	-	-	-	-	3.35	11-17	7.05	10-11	R	Affected by pumping. Meas. started 9-12-57.
15-1	1950-57	11.40	4- 1-50	17.36	8- 3-55	13.37	1-2	17.0	8-1	W	Affected by pumping.
Montmorency County											
32N 2E 34-1	1948-57	17.41	5-15-52	20.97	8-17-49	19.21	10-9	20.81	11-8	Q	
31N 2E 11-1	1934-57	7.40	3-29-38	dry	10-27-39	9.84	7-16	11.82	1-8	Q	
14-1	1948-57	11.79	5-15-52	14.81	10-31.56		(14.76, 10-24)			A	
31N 3E 9-1	1936-44, 48-57	2.85	4-21-52	7.76	12-15-49	5.46	7-16	7.82	1-8	Q	
31N 4E 8-1	1935-53, 55-57	0.06	6-19-51	4.84	9- 4-36		(2.06, 10-9)			A	
34-1	1935-37, 46-53, 55-57	0.02	4-15-36	1.05	7-17-50		(0.79, 10-9)			A	
30N 2E 6-1	1945-53, 55-57	+0.55	6-19-51	3.98	12-15-49		(0.85, 10-24)			A	
30N 4E 26-1	1935-37, 45-57	+0.78	7- 2-45	2.33	9-23-48	0.05	4-26	0.90	10-9	Q	

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes								F 57	Remarks
		Through 1956				1957					
		Highest	Date	Lowest	Date	Highest	Date	Lowest	Date		
Montmorency County - Continued											
29N 2E 22-1	1948-53, 57	+11.39	4-19-56	4.95	1-29-49	-	-	-	-	-	Meas. discontinued
27-1	1945-53, 55-57	+1.20	4-18-46	1.98	9-27-49		(1.17, 10-9)			A	
29N 3E 21-1	1945-57	2.63	5-15-52	5.91	1-27-56	3.15	7-16	5.44	1-8	Q	
29N 4E 5-1	1945-53, 55-57	2.75	3-18-53	dry	11- 1-46		(8.35, 10-9)			A	
Oakland County											
3N 10E 31-1	1952-57	109.2	1- 5-53	128.0	8- 6-55	109.3	12-1	117.4	8-10	R	Affected by pumping.
32-1	1939-57	59.55	4-22-40	129.5	8- 5-55	110.1	6-2	119.5	8-10	R	Do.
2N 10E 22-1	1950-57	11.00	4-30-56	17.60	9-26-55	11.01	12-31	16.00	10-7	W	Do.
Ogemaw County											
23N 1E 4-1	1934, 55-57	1.97	5-19-55	4.26	10-10-55	1.73	7-15	3.24	1-7	Q	
17-1	1934, 55-57	4.34	5-19-55	7.04	10-10-55		(6.58, 10-10)			A	
23N 2E 2-1	1951-57	0.37	5- 5-52	4.05	3- 1-56	1.67	7-15	2.86	1-7	R	
Otsego County											
29N 3W 29-1	1933-57	5.56	5-14-47	9.68	9-16-41	8.24	7-17	9.47	12-24	Q	
32-1	1935-57	0.67	4-17-47	4.59	8-26-41		(4.39, 10-7)			A	
Presque Isle County											
33N 2E 18-1	1933-44, 48-52, 55-57	2.05	3-29-38	5.74	10-18-49		(3.42, 10-9)			A	
29-1	1934-44, 48-52, 55-57	6.87	3-29-38	9.79	10-18-49		(8.69, 10-9)			A	
30-1	1934-44, 48-57	1.80	5-23-38	5.69	1-27-56	2.62	7-16	4.40	1-8	Q	
32-1	1934-44, 48-52, 55-57	5.86	3-29-38	10.58	10-18-49		(8.58, 10-9)			A	
Roscommon County											
24N 3W 3-1	1934-57	10.20	7- 7-54	13.26	12-14-49		(12.46, 10-10)			A	
24-1	1934-57	5.95	7- 9-43	11.62	12-13-49	8.44	7-15	10.62	1-7	Q	
24N 2W 1-1	1934-57	6.68	4-17-52	11.53	12-14-49	-	-	-	-	-	Not measured in 1957.
7-1	1934-57	5.18	7- 7-54	8.62	9-17-45		(7.41, 10-10)			A	
19-1	1934-57	1.15	6-15-43	6.05	11-11-49		(3.25, 10-24)			A	
20-1	1934-57	2.78	5- 3-51	6.23	12- 6-49	3.32	7-12	5.63	1-25	R	
21-1	1939-57	1.98	4-17-52	8.07	12-13-49		(3.94, 10-24)			A	
24N 1W 34-1	1934-57	14.40	6-15-43	dry	11- 6-39	15.60	7-15	16.99	1-7	Q	
23N 3W 12-1	1938-57	5.21	6-15-43	10.15	8-16-54		(8.74, 10-24)			A	
25-1	1934-57	3.44	4-17-52	6.76	8-14-36	3.45	7-15	5.57	1-7	Q	
23N 2W 31-1	1949-57	1.55	4-17-52	4.78	10-11-55		(2.58, 10-24)			A	
23N 1W 3-1	1939-57	1.62	6-15-43	7.31	12-14-49	2.83	7-15	5.43	1-7	Q	
22N 4W 15-1	1934-46, 48-57	1.29	11-16-45	5.29	9-20-54		(3.77, 10-11)			A	
22N 3W 22-1	1934-57	3.25	4-17-52	8.25	12-13-49	3.36	7-15	6.86	1-7	Q	
34-1	1934-37, 39-57	2.54	6-15-43	8.45	12-13-49		(4.52, 10-10)			A	
22N 2W 14-1	1934-56	2.93	10-14-41	7.35	10-14-48	-	-	-	-	A	Not measured in 1957.
17-1	1934-57	1.34	4- 1-38	5.38	11- 9-49	1.87	7-15	3.83	1-7	Q	
22N 1W 11-1	1934-57	1.10	6-15-43	6.22	11-11-49		(3.89, 10-10)			A	
21N 4W 4-1	1939-57	1.28	4-21-41	7.14	10-12-49		(5.16, 10-11)			A	
13-1	1935-57	1.54	6-16-45	5.95	10-14-48		(4.14, 10-11)			A	
21N 3W 2-1	1936-57	11.96	7- 9-43	15.98	4- 2-40		(13.75, 10-10)			A	
5-1	1934-57	9.61	6-15-43	11.81	11-11-49		(10.22, 7-15)			A	
Saginaw County											
9N 3E 16-1	1950-57	39.66	11-23-51	dry	summers	51.36	2-3	dry	5-12	W	Affected by pumping. Meas. stopped 6-30-57.
St. Joseph County											
6S 11W 18-1	1939-57	+2.90	5-22-53	5.70	9-27-47	+0.40	4-26	2.40	12-27	W	Affected by pumping.
Sanilac County											
12N 13E 33-1	1948-57	15.45	4-25-51	23.42	2- 1-56	16.40	5-20	21.95	1-2	W	

Table 2.--Extremes in ground-water levels in observation wells in Michigan.--Continued
(in feet below or above (+) land surface)

Well number	Years of record	Observed water-level extremes: Through 1956 Highest	Date	Lowest	Date	1957 Highest	Date	Lowest	Date	F 57	Remarks
Schoolcraft County											
47N 16W 30-1	1957	-	-	-	-	13.88	9-25	15.51	11-7	R	Started 7-25-57.
45N 13W 16-1	1952-57	5.09	4-12-54	6.28	9-26-55	5.24	3-15	5.95	8-13	R	
Shiawassee County											
5N 2E 16-1	1948-57	17.28	5- 3-50	21.10	10-30-53	18.25	7-20	19.92	10-17	Q	
Washtenaw County											
3S 6E 16-1	1920-57	e+2.5	2- -30	e10.0	11- -27	+0.12	4-28	7.47	9-25	W	Affected by pumping. e - estimated
16-2	1948-57	+2.00	6-30-51	15.31	8-30-53	0.20	4-28	15.50	8-21	W	Affected by pumping.
3S 7E 24-1	1943-45, 49-57	5.79	1- 5-50	16.43	10-16-56	13.12	11-7	15.59	2-28	M	Do.
24-2	1943-45, 49-57	11.81	7-13-43	30.46	10-16-56	22.15	11-7	31.57	5-10	M	Do.
24-4	1943-45, 49-57	11.55	1- 5-50	31.68	10-16-56	22.61	11-7	33.0	5-10	M	Do.
24-5	1943-45, 49-57	15.15	6- 6-45	34.12	12-17-56	31.97	12-4	37.76	5-22	M	Do.
24-6	1944-45, 49-57	5.69	2-15-50	25.87	8- 2-56	16.53	11-7	26.22	5-10	M	Do.
24-7	1955-57	23.47	12-29-55	36.05	10-16-56	34.31	11-7	35.77	5-10	M	Do.
4S 6E 9-1	1946-57	51.22	5-15-48	88.14	6-17-49	73.39	5-6	80.06	10-11	W	Do.
10-1	1946-57	61.48	6-12-53	88.27	7- 8-55	67.20	11-1	86.92	4-5	W	Do.
Wexford County											
24N 10W 22-1	1935-37, 41-44, 48-52, 55-57	1.40	8- 6-43	3.88	10-30-56		(4.15, 10-25)			A	
26-1	1935-37, 44, 48-52, 55-57	0.99	3-27-36	3.15	10-30-56		(2.77, 10-25)			A	
28-1	1935-37, 41-44, 48-57	5.20	8- 6-43	9.36	1-11-56	8.63	7-17	9.99	10-25	Q	
36-1	1935-37, 41-44, 48-52, 55-57	2.70	3-27-36	5.63	8-19-36		(4.64, 10-25)			A	
24N 9W 19-1	1935-37, 41-44, 49-57	0.94	4-10-51	3.74	8-19-36	1.17	4-30	2.13	10-25	Q	
27-1	1935-37, 41-44, 49-53, 55-57	0.00	3-21-50	dry	1-10-49		(13.03, 10-25)			A	
21N 11W 13-1	1948-57	46.28	6- 5-52	49.78	4-18-56	49.34	1-10	50.16	12-31	Q	
21N 9W 4-1	1949-57	19.99	7- 6-53	23.24	2-14-51	22.06	1-10	22.97	10-25	Q	Do.