GROUND-WATER DATA FOR MICHIGAN 1982

by G. C. Huffman

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UNITED STATES DEPARTMENT OF THE INTERIOR

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Altitude. The vertical distance of a point or line above or below the National Geodetic Vertical Datum of 1929. The National Geodetic Vertical Datum of 1929 (NGVD of 1929) is a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. In this report, all altitudes are above NGVD of 1929.

ACKNOWLEDGEMENTS

Acknowledement is made to personnel of Federal and State agencies, county and township governments, industrial concerns, well drillers, consultants, municipalities, and public utilities, without whose cooperation the accumulation of data presented in this report would have not been possible.

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ABSTRACT

Water levels, locations, depths, and aquifers tapped are given for 117 observation wells. Tabulated data include extremes of water levels for 1982 and for the period of record, pumpage of most major ground-water users in the State, and quality data on selected wells. The largest reported user of ground-water, the city of Lansing, pumped 8.2 billion gallons from the Saginaw Formation and glacial deposits.

INTRODUCTION

Purpose

This report makes available, through 1982, the records of water levels and related data for the principal aquifers of the State. It is written for municipalities, industries, institutions, consultants, drillers, hydrologists and other people interested in ground-water resources.

Scope

Data on yield of wells, pumpage, quality of water, and trends of ground-water levels for the past 5 years are shown in the text. Many hydrographs are included to illustrate changes in water levels. Records of water levels in observation wells, records of pumpage by most major ground-water users, and water-quality data from selected wells sampled during 1982 are given in tables 1, 2, and 3. Distribution of observation wells is shown in figure 1. Locations of wells selected for collection of water-quality samples and years sampled are shown in figure 2.

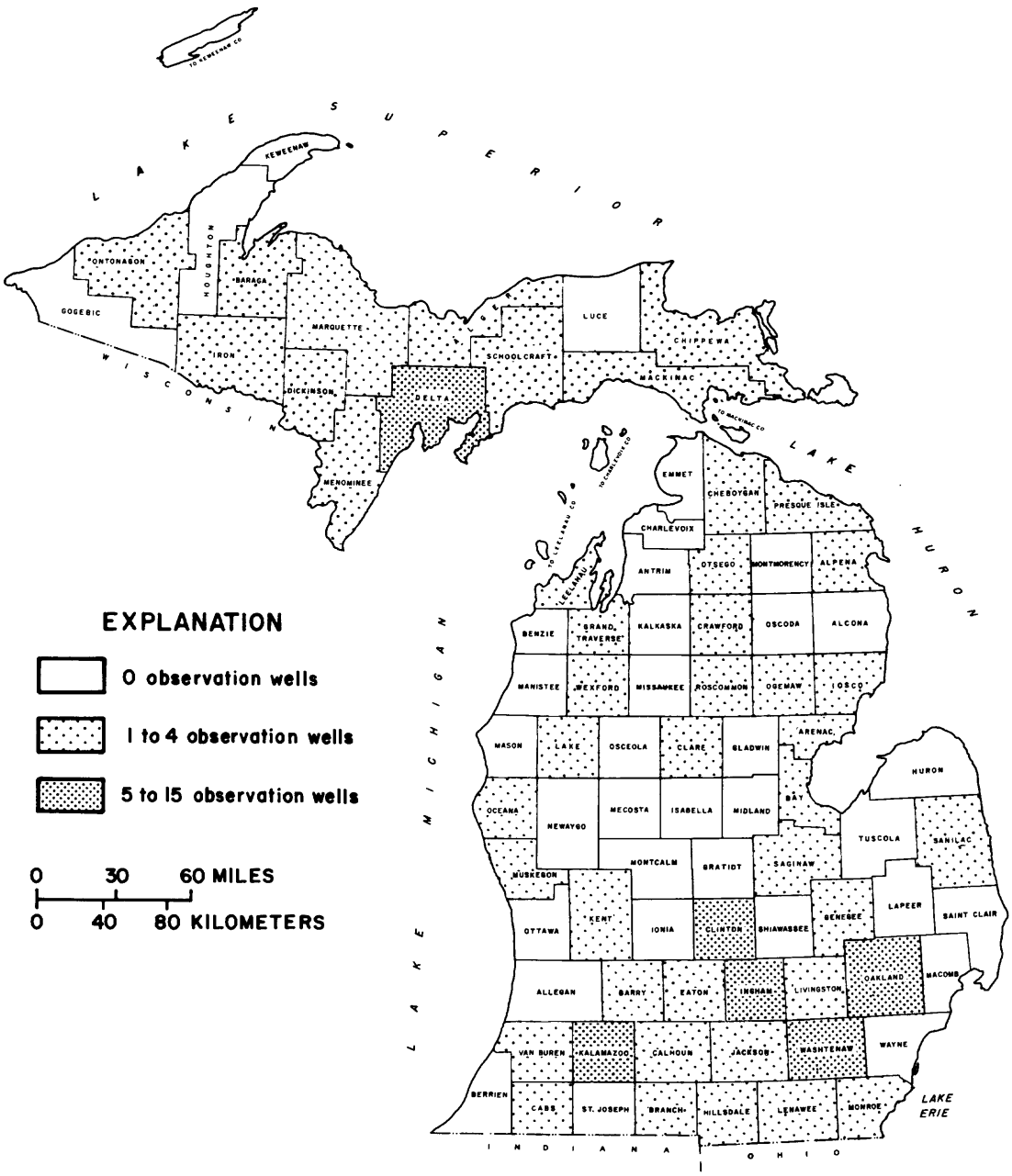


Figure 1.--Distribution of observation wells. Water levels were monitored in 117 observation wells in 1982.

Use of data

The quantity of water available from an aquifer can be determined by analysis of records of water levels and pumpage. Water-level records in pumped areas, obtained by recorders, indicate day-to-day and long-term effects of pumping. This information can be used by municipalities, industries, and institutions to estimate the capacity of aquifers to meet present and future demands for water and to determine whether expansion of present supply systems for ground water is practicable. In an area where the water level is declining because of pumping, projection of future water levels indicates the depth below which an intake should be installed. Allowing for lower water levels can extend the life of the installation.

Normally, the water table fluctuates 2 to 3 feet annually and about 5 feet over a period of years. If an excavation for a basement or septic tank is made when the water table is low, good construction practices would allow for probable higher water levels in the spring. If construction is made after several years of drought, the allowance for rising water levels should be greater. If a site is at all questionable, the depth to the water table can be determined by test borings.

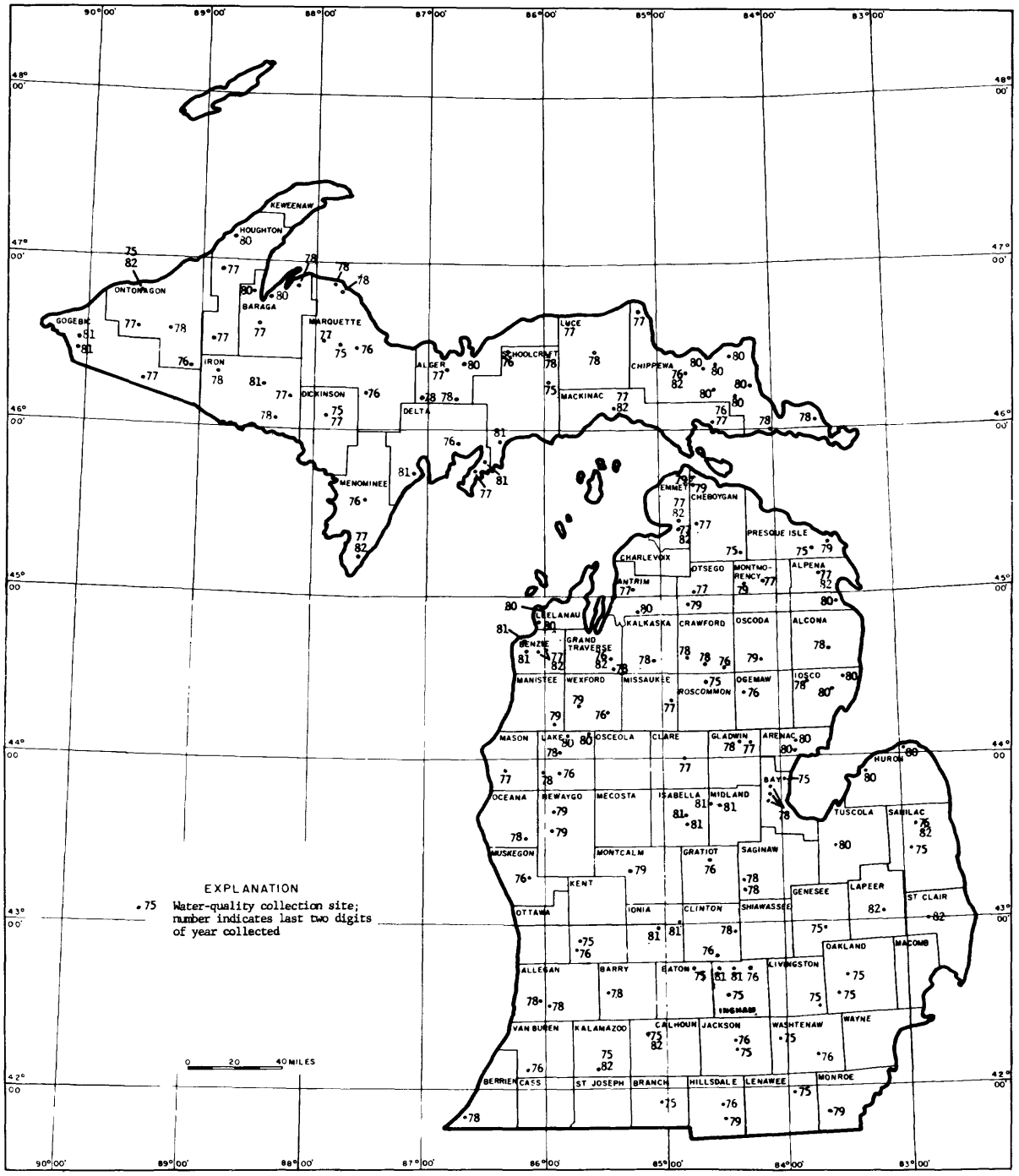


Figure 2.--Water-quality collection sites and year sample collected (water-quality data are given in the annual ground-water report for year in which sample was collected except that data for the years 1975-76 are in the annual report for 1977).

Ground-water records and reports

Tabulations of water-level measurements, hydrographs for observation wells, records of chemical quality, water-temperature measurements, well records and logs, aquifer tests, records of pumping for public and industrial supplies, and water-resouurces reports are on file for public inspection. They may be examined at the Geological Survey Division, Michigan Department of Natural Resouurces, Mason Building, Lansing, Michigan 48909; or at the U.S. Geological Survey, 6520 Mercantile Way, Suite 5, Lansing, Michigan 48910. Records for the Upper Peninsula are also kept on file in the State and Federal Geological Survey Offices, State Office Building, Escanaba, Michigan 48929.

Records of ground-water levels from 1935 to 1974 are in U.S. Geological Survey Water-Supply Papers (WSP). Records since 1975 are in U.S. Geological Survey Water-Data Reports (WDR). Annual reports, titled "Summary of Ground-Water Conditions in Michigan," were begun in 1956 to supplement the Water-Supply Paper and Water-Data Report series. The title of the report was changed to "Summary of Ground-Water Hydrological Data in Michigan," in 1967 and to "Ground-Water Data for Michigan" in 1973.

Reports that describe ground water in Michigan are shown in figures 3 and 4. In addition, many publications dealing with ground water are listed in the selected references at the end of this report.

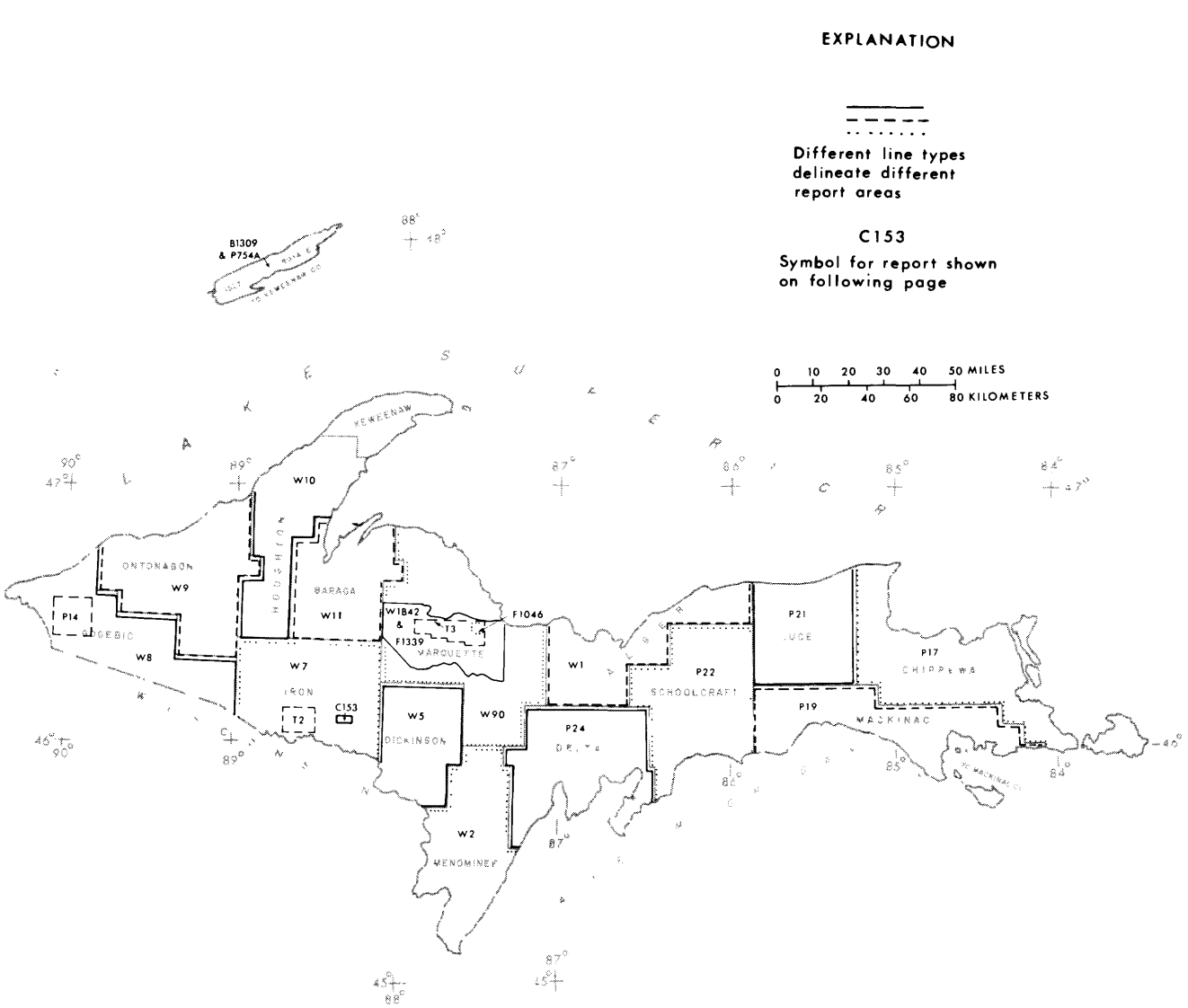


Figure 3.--Areas in the Upper Peninsula where ground-water conditions are described in published reports.

PUBLISHED REPORTS

Upper Peninsula

B1309 -- Huber, N. K., 1975, The geologic story of Isle Royale National Park: U.S. Geological Survey Bulletin 1309.

C153 -- Pettijohn, F. J., 1952, Geology of the northern Crystal Falls area, Iron County, Michigan: U.S. Geological Survey Circular 153.

F1046 -- Grannemann, N. G., 1978, Water supply potential of the Lake Sally system, Marquette County Michigan: U.S. Geological Survey Open-File Report 78-1046.

F1339 -- _____, 1979, Water resources of the Marquette Iron Range area, Marquette County, Michigan: U.S. Geological Survey Open-File Report 79-1339.

P14 -- Brown, E. A., and Stuart, W. T., 1951, Ground-water resources of the glacial deposits in the Bessemer area, Michigan: Michigan Geological Survey Progress Report 14.

P17 -- Vanlier, K. E., and Deutsch, Morris, 1958, Reconnaissance of the ground-water resources of Chippewa County, Michigan: Michigan Geological Survey Progress Report 17.

P19 -- _____, 1958, Reconnaissance of the ground-water resources of Mackinac County, Michigan: Michigan Geological Survey Progress Report 19.

P21 -- Vanlier, K. E., 1959, Reconnaissance of the ground-water resources of Luce County, Michigan: Michigan Geological Survey Progress Report 21.

P22 -- Sinclair, W. C., 1959, Reconnaissance of the ground-water resources of Schoolcraft County, Michigan: Michigan Geological Survey Progress Report 22.

P24 -- _____, 1960, Reconnaissance of the ground-water resources of Delta County, Michigan: Michigan Geological Survey Progress Report 24.

P754A -- Huber, N. K., 1973, Glacial and postglacial geologic history of Isle Royale National Park, Michigan: U.S. Geological Survey Professional Paper 754-A.

T2 -- Stuart, W. T., Theis, C. V., and Stanley, G. M., 1948, Ground-water problems in the Iron River district, Michigan: Michigan Geological Survey Technical Report 2.

T3 -- Stuart, W. T., Brown, E. A., and Rhodehamel, E. C., 1954, Ground-water investigations of the Marquette iron-mining district, Michigan: Michigan Geological Survey Technical Report 3.

W1 -- Vanlier, K. E., 1963, Reconnaissance of the ground-water resources in Alger County, Michigan: Michigan Geological Survey Water Investigation 1.

W2 -- _____, 1963, Ground water in Menominee County: Michigan Geological Survey Water Investigation 2.

W5 -- Hendrickson, G. E., and Doonan, C. J., 1966, Ground-water resources of Dickinson County, Michigan: Michigan Geological Survey Water Investigation 5.

W7 -- Doonan, C. J., Hendrickson, G. E., 1967, Ground water in Iron County, Michigan: Michigan Geological Survey Water Investigation 7.

W8 -- _____, 1968, Ground water in Gogebic County, Michigan: Michigan Geological Survey Water Investigation 8.

W9 -- _____, 1969, Ground water in Ontonagon County, Michigan: Michigan Geological Survey Water Investigation 9.

W10 -- Doonan, C. J., Hendrickson, G. E., and Byerlay, J. R., 1970, Ground water and geology of Keweenaw Peninsula, Michigan: Michigan Geological Survey Water Investigation 10.

W11 -- Doonan, C. J., and Byerlay, J. R., 1973, Ground water and geology of Baraga County, Michigan: Michigan Geological Survey Water Investigation 11.

W90 -- Twenter, F. R., 1981, Geology and hydrology for environmental planning in Marquette County, Michigan: U.S. Geological Survey Water Resources Investigations, 80-90.

W1842 -- Wiitala, S. W., Newport, T. G., and Skinner, E. L., 1967, Water resources of the Marquette Iron Range area, Michigan: U.S. Geological Survey Water-Supply Paper 1842.

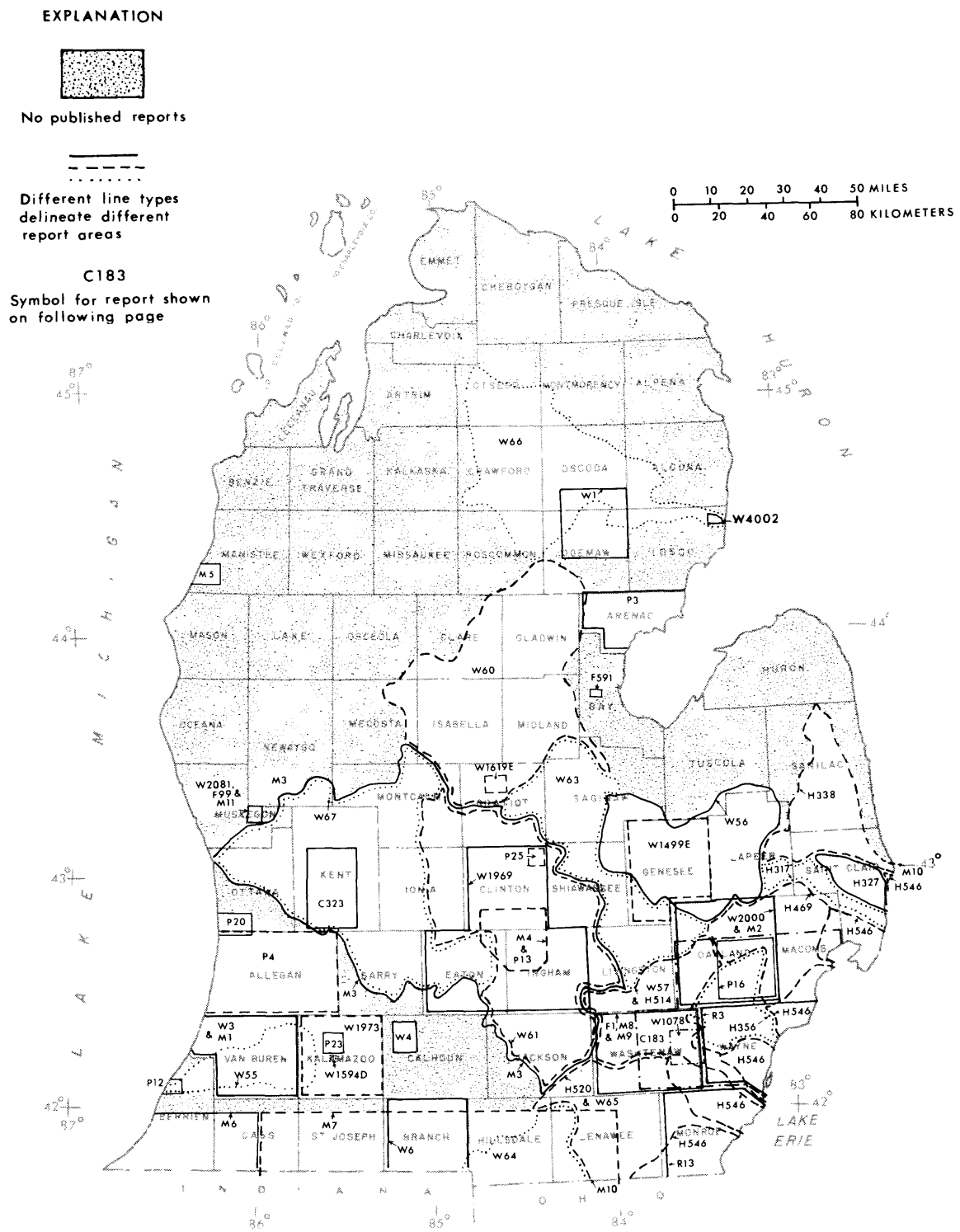


Figure 4.--Areas in the Lower Peninsula where ground-water conditions are described in published reports.

PUBLISHED REPORTS

Lower Peninsula

C183 -- Wisler, C. O., Stramel, G. J., and Laird, L. B., 1952, Water resources of the Detroit area, Michigan: U.S. Geological Survey Circular 183.

C323 -- Stramel, G. J., Wisler, C. O., and Laird, L. B., 1954, Water resources of the Grand Rapids area, Michigan: U.S. Geological Survey Circular 323.

F1 -- Fleck, W. B., 1974, Geology and hydrology for environmental planning in Washtenaw County, Michigan: U.S. Geological Survey Open-File Report unnumbered.

F99 -- McDonald, M. G., and Fleck, W. B., 1978, Model analysis of the impact on ground-water conditions of the Muskegon County wastewater disposal system, Michigan: U.S. Geological Survey Open-File Report 78-99.

F591 -- Stark, J. R., and McDonald, M. G., 1980, Ground water of coal deposits, Bay County, Michigan: U.S. Geological Survey Open-File Report 80-591.

H317 -- Knutilla, R. L., 1969, Water resources of the Belle River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-317.

H327 -- _____, 1969, Water resources of the Pine River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-327.

H338 -- _____, 1970, Water resources of the Black River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-338.

H356 -- _____, 1971, Water resources of the River Rouge basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-356.

H469 -- Nowlin, J. O., 1973, Water resources of the Clinton River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-469.

H514 -- Larson, R. W., Allen, W. B., and Hanson, S. D., 1975, Water resources of the Huron River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-514.

H520 -- Knutilla, R. L., and Allen, W. B., 1975, Water resources of the River Raisin basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-520.

H546 -- Twenter, F. R., Knutilla, R. L., Cummings, T. R., 1975, Water resources of basins for minor streams draining into St. Clair River, Lake St. Clair, Detroit River, and Lake Erie, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-546.

M1 -- Terwilliger, F. W., 1954, The glacial geology and ground-water resources of Van Buren County, Michigan, pt. 1 of Occasional papers for 1954 on the geology of Michigan: Michigan Geological Survey Publication 48.

M2 -- Mozola, A. J., 1954, A survey of ground-water resources in Oakland County, Michigan, pt. 2 of Occasional papers for 1954 on the geology of Michigan: Michigan Geological Survey Publication 48.

M3 -- Vanlier, K. E., 1968, Comprehensive planning study of the Grand River basin, Michigan, Appendix E, Ground-water resources and geology of the Grand River basin, Michigan: U.S. Army Engineers District, Detroit, Michigan.

M4 -- Vanlier, K. E., and Wheeler, M. L., 1968, Analog simulation of ground-water development of the Saginaw Formation, Lansing metropolitan area, Michigan: Tri-County Planning Commission, Lansing Ground-Water Report.

M5 -- Childs, K. E., 1970, History of the salt, brine, and paper industries and their probable effect on the ground-water quality in the Manistee Lake area, Michigan: Michigan Department of Natural Resources.

M6 -- Schneider, A. F., and Keller, S. J., 1970, Indiana Geological Survey regional geological map number 4: Indiana Department of Natural Resources.

M7 -- Johnson, G. H., and Keller, S. J., 1972, Indiana Geological Survey regional geological map number 8: Indiana Department of Natural Resources.

M8 -- Twenter, F. R., Knutilla, R. L., and Nowlin, J. O., 1976, Water resources of Washtenaw County, Michigan: Washtenaw County Metropolitan Planning Commission.

M9 -- Borton, T. E., 1974, Planning perspectives on water resources, Washtenaw County, Michigan: Washtenaw County Metropolitan Planning Commission.

M10 -- Twenter, F. R., 1975, Ground water and geology -- southeastern Michigan: U.S. Army Corps of Engineers.

M11 -- Fleck, W. B., and McDonald, M. G., 1978, Three-dimensional finite-difference model of ground-water system underlying the Muskegon County wastewater disposal system, Michigan: U.S. Geological Survey Journal of Research, volume 6, number 3.

P3 -- Pringle, G. H., 1937, Geology of Arenac County, Michigan: Michigan Geological Survey Progress Report 3.

P4 -- Riggs, C. H., 1938, Geology of Allegan County, Michigan: Michigan Geological Survey Progress Report 4.

P12 -- Stuart, W. T., and Stallman, R. W., 1945, Ground-water resources of the Benton Harbor area, Michigan: Michigan Geological Survey Progress Report 12.

P13 -- Stuart, W. T., 1945, Ground-water resources of the Lansing area, Michigan: Michigan Geological Survey Progress Report 13.

P16 -- Ferris, J. G., and others, 1954, Ground-water resources of southeastern Oakland County, Michigan: Michigan Geological Survey Progress Report 16.

P20 -- Deutsch, Morris, Burt, E. M., and Vanlier, K. E., 1958, Summary of ground-water investigations in the Holland area, Michigan: Michigan Geological Survey Progress Report 20.

PUBLISHED REPORTS--Continued

Lower Peninsula

P23 -- Deutsch, Morris, Vanlier, K. E., and Giroux, P. R., 1960, Ground-water hydrology and glacial geology of the Kalamazoo area, Michigan: Michigan Geological Survey Progress Report 23.

P25 -- Vanlier, K. E., 1962, Summary of ground-water investigations in the Elsie area, Michigan: Michigan Geological Survey Progress Report 25.

R3 -- Mozola, A. J., 1969, Geology for land and ground-water development in Wayne County, Michigan: Michigan Geological Survey Report Investigation 3.

R13 -- _____, 1970, Geology for environmental planning in Monroe County, Michigan: Michigan Geological Survey Report Investigation 13.

W1 -- Knutilla, R. L., Twenter, F. R., and Larson, R. W., 1971, Upper Rifle River Basin -- An Evaluation of its Water Resources and Hydrologic Environment: Michigan Geological Survey Water Information Series Report 1.

W3 -- Giroux, P. R., Hendrickson, G. E., Stoimenoff, L. E., and Whetstone, G. W., 1964, Water resources of Van Buren County, Michigan: Michigan Geological Survey Water Investigation 3.

W4 -- Vanlier, K. E., 1966, Ground-water resources of the Battle Creek area, Michigan: Michigan Geological Survey Water Investigation 4.

W6 -- Giroux, P. R., Stoimenoff, L. E., Nowlin, J. O., and Skinner, E. L., 1966, Water resources of Branch County, Michigan: Michigan Geological Survey Water Investigation 6.

W55 -- Water resource conditions and uses in the Paw Paw River Basin, 1955, (revised report in 1964): Michigan Water Resources Commission Report.

W56 -- Water resource conditions and uses in the Flint River Basin, 1956: Michigan Water Resources Commission Report.

W57 -- Water resource conditions and uses in the Huron River Basin, 1957: Michigan Water Resources Commission Report.

W60 -- Water resource conditions and uses in the Tittabawassee River Basin, 1960: Michigan Water Resources Commission Report.

W61 -- Water resource conditions and uses in the Upper Grand River Basin, 1961: Michigan Water Resources Commission Report.

W63 -- Water resource conditions and uses in the Shiawassee River Basin, 1963: Michigan Water Resources Commission Report.

W64 -- Water resource conditions and uses in the Maumee River Basin, 1964: Michigan Water Resources Commission Report.

W65 -- Water resource conditions and uses in the River Raisin Basin, 1965: Michigan Water Resources Commission Report.

W66 -- Water resource conditions and uses in the Au Sable River Basin, 1966: Michigan Water Resources Commission Report.

W67 -- Water resource conditions and uses in the Lower Grand River Basin, 1967, (open file): Michigan Water Resources Commission Report.

W1078 -- McGuinness, C. L., Poindexter, O. F., and Otten, E. G., 1949, Ground-water supplies of the Ypsilanti area, Michigan: U.S. Geological Survey Water-Supply Paper 1078.

W1499E -- Wiitala, S. W., Vanlier, K. E., and Krieger, R. A., 1963, Water resources of the Flint area, Michigan: U.S. Geological Survey Water-Supply Paper 1499-E.

W1594D -- Reed, J. E., Deutsch, Morris, and Wiitala, S. W., 1966, Induced recharge of an artesian glacial-drift aquifer at Kalamazoo, Michigan: U.S. Geological Survey Water-Supply Paper 1594-D.

W1619E -- Vanlier, K. E., 1963, Ground-water resources of the Alma area, Michigan: U.S. Geological Survey Water-Supply Paper 1619-E.

W1969 -- Vanlier, K. E., Wood, W. W., and Brunett, J. O., 1973, Water-supply development and management alternatives for Clinton, Eaton, and Ingham Counties, Michigan: U.S. Geological Survey Water-Supply Paper 1969.

W1973 -- Allen, W. B., Miller, J. B., and Wood, W. W., 1972, Availability of water in Kalamazoo County, Michigan: U.S. Geological Survey Water-Supply Paper 1973.

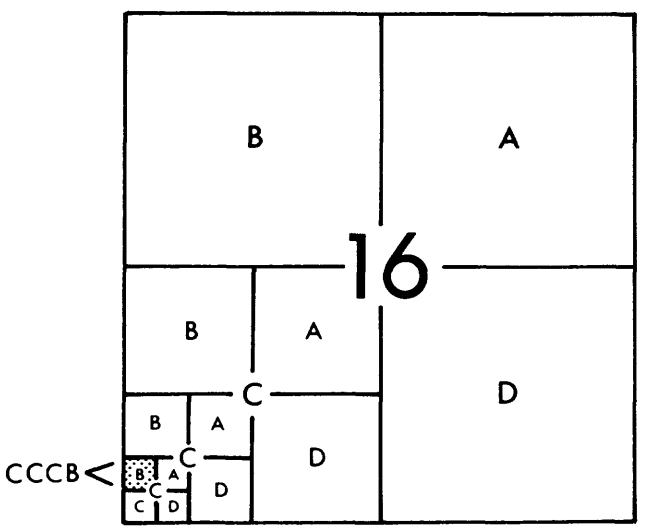
W2000 -- Twenter, F. R., and Knutilla, R. L., 1972, Water for a rapidly growing urban community -- Oakland County, Michigan: U.S. Geological Survey Water-Supply Paper 2000.

W2081 -- McDonald, M. G., 1980, Hydraulic characteristics of an underdrained irrigation circle, Muskegon County wastewater disposal system, Michigan: U.S. Geological Survey Water-Supply Paper 2081.

W4002 -- Stark, J. R., Cummings, T. R., and Twenter, F. R., 1983, Ground-water contamination at Wurtsmith Air Force Base, Michigan: U.S. Geological Survey Water Resources Investigation Report 83-4002.

Well-numbering system

The well-numbering system for Michigan indicates the location of wells within the rectangular subdivision of the land with reference to the Michigan meridian and base line. The first two segments of the well number designate township and range, the third segment of the number designates the section, and the letters A through D designate successively smaller subdivisions of the section, as shown below. Thus, a well designated as 32N 6E 16CCCB is located to the nearest 2.5 acres and is within the shaded area in section 16.



For many wells in this report, locations are only given to the nearest 40-acre tract, for example, 16CC. In the event that two or more wells are in the same tract, sequential number designation is added--for example, 16CCCB1, 16CCCB2, etc. The Michigan Geological Survey uses a similar system except that numbers are used instead of letters.

GROUND-WATER LEVELS

Water levels, measured in 117 observation wells throughout the State (fig. 1 and table 1) in 1982, generally follow precipitation trends. Above average levels usually occur in areas where precipitation has been above normal; below average levels in areas where precipitation has been below normal. Although quantity of precipitation is a major factor affecting ground-water levels, many other natural factors, such as soil condition; nature of underlying rock; and slope of the land surface affect the levels.

Hydrographs of water levels in wells (fig. 5) show that levels are highest in the spring. At this time, snowmelt and rain normally result in large additions to ground-water reservoirs. However, ice cover or frost in the ground can impede infiltration. Under these conditions, most water from snowmelt and precipitation runs off rapidly, and little goes to recharge the ground-water reservoirs. Recharge is small during the growing season, as most rainfall is evaporated, transpired by vegetation, or runs off overland after heavy showers. In the fall, evapotranspiration is reduced by cold weather. At this time, heavy rains may cause water levels to rise. Frozen ground impedes infiltation of water during winter.

In addition to changes in water levels from precipitation, temporary changes in levels may be caused by earth tides and variation in barometric pressure. Evapotranspiration causes small daily declines in water levels in some wells. Pumping withdrawals can have a major effect on water levels. If withdrawals are greater than recharge, declining levels will occur and may eliminate precipitation trends. Uniform pumping rates throughout the year, however, may still allow levels to follow precipitation trends.

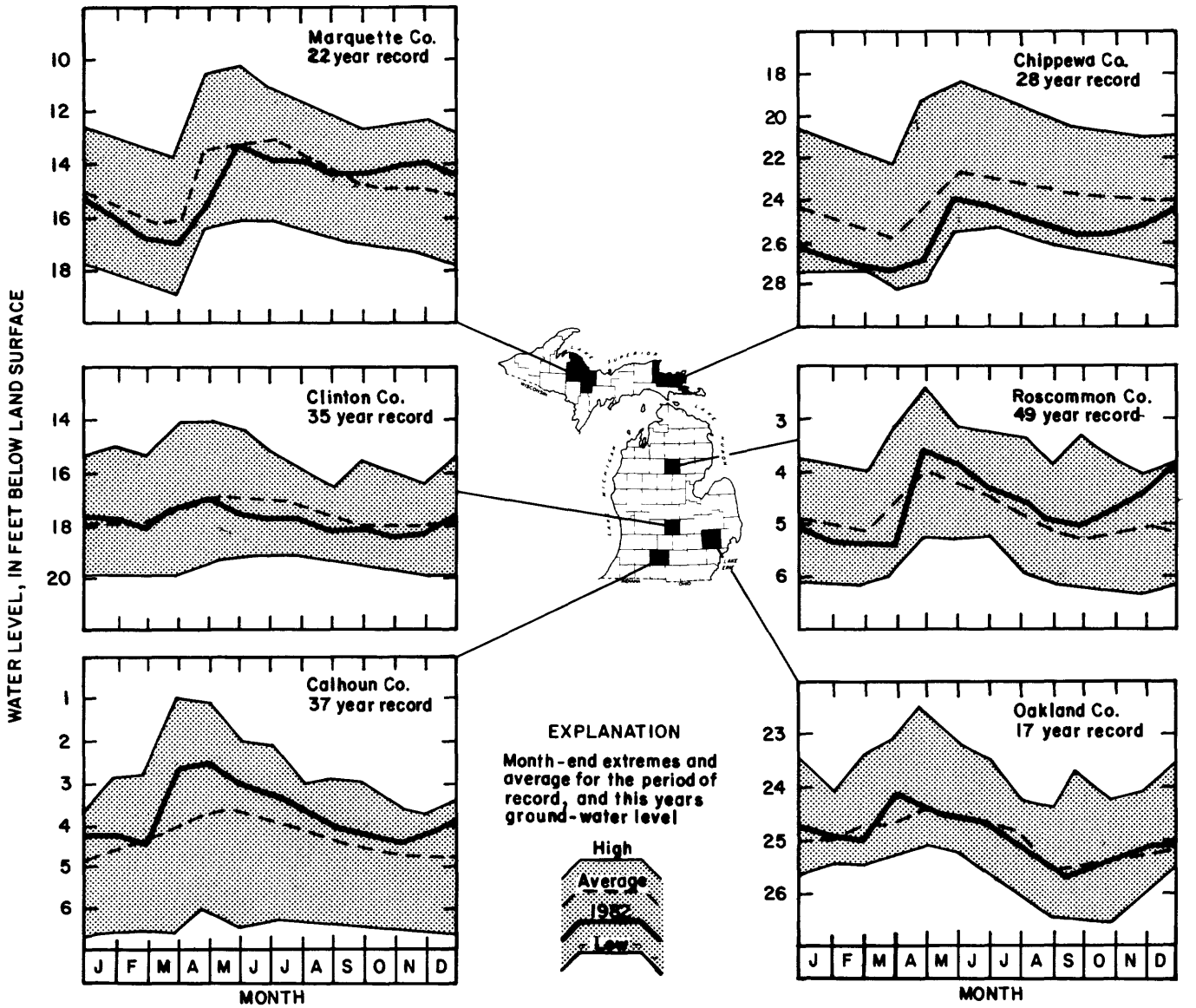
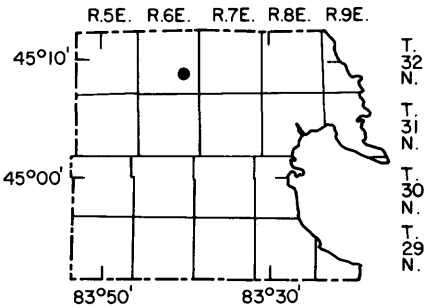
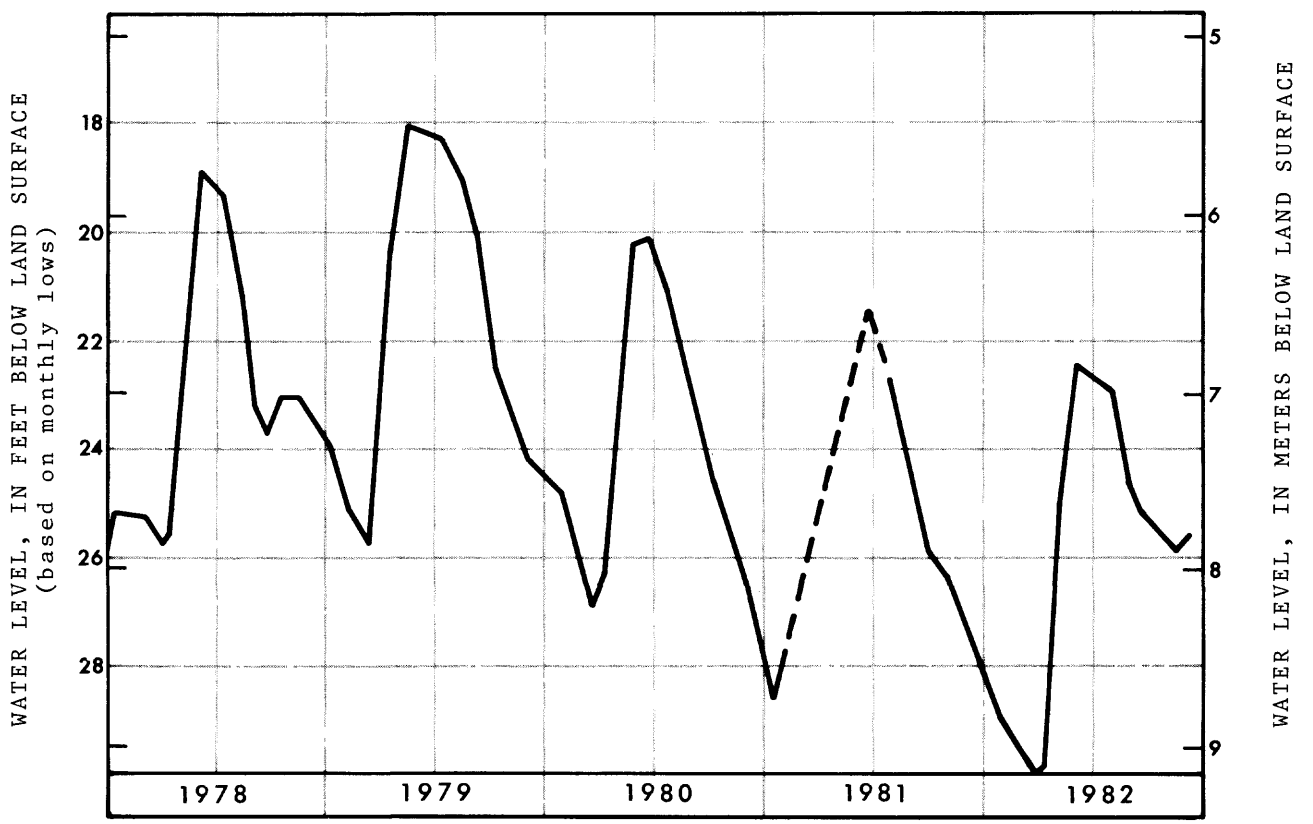


Figure 5.--Water levels in selected wells, 1982.

AREA GROUND-WATER DATA

Descriptions of some Michigan ground-water supplies follow alphabetically, by counties. Yield of wells and pumpage data are given as reported by water departments and consultants. Chemical-quality data are for ground water and are based on latest analyses made by the Michigan Department of Health. Where more than one well is involved, a range in quality is generally given. For some analyses, referred to as composite, sample was a mixture of water from several wells. The unit milligrams per liter (mg/L) can be considered to be numerically equal to parts per million (ppm). Illustrations show water-level trends. Dissolved solids (diss. solids) indicate total amount of dissolved mineral constituents in water.





Geological Survey well 32N 6E 23DDDA1 is 88 feet deep and in sand. Water-quality data in ground-water report for 1977 (Huffman, 1979).

BRANCH COUNTY - CITY OF COLDWATER

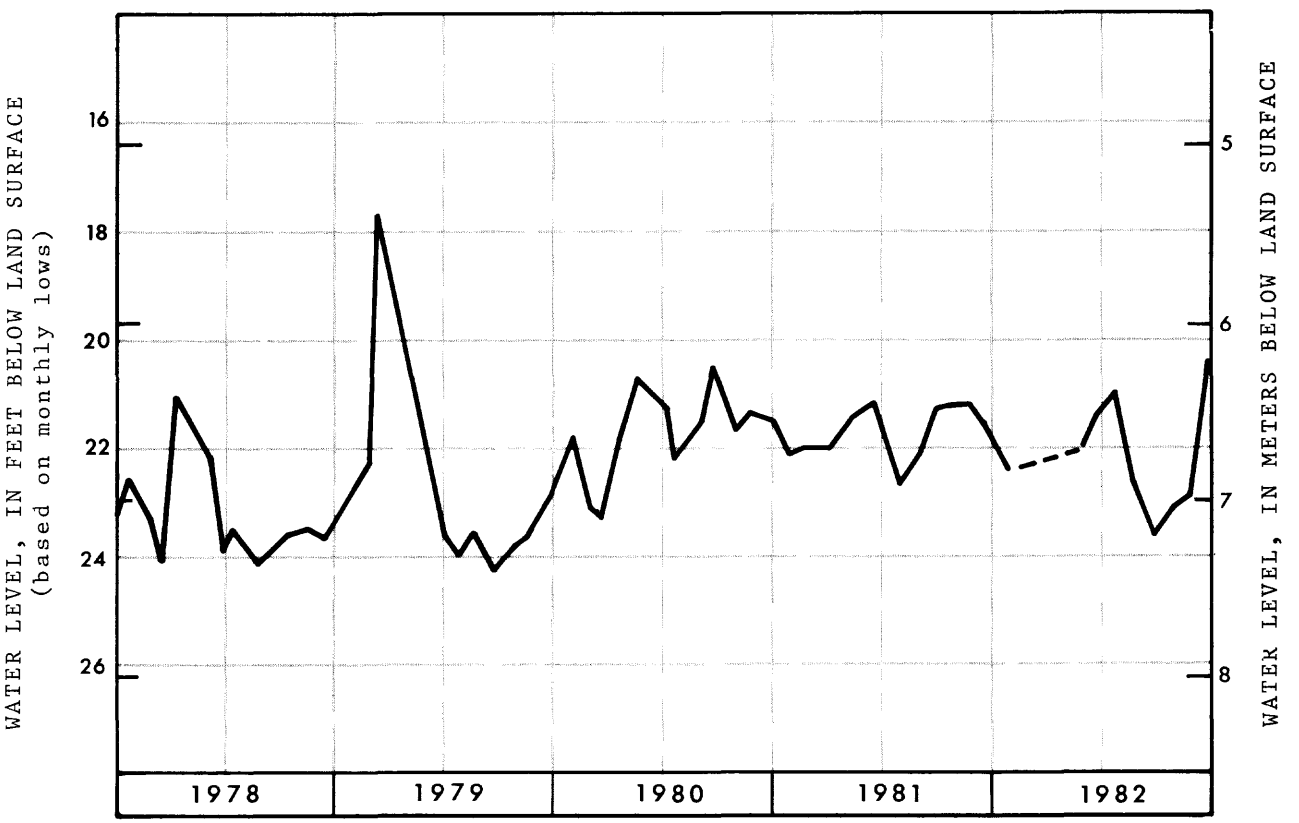
SUPPLY AND SOURCE -- 4 wells, 117 to 129 feet deep, tap glacial deposits.

YIELD OF WELLS -- 1,200 to 2,850 gal/min; specific capacity -- 80 to 190 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982 - 1,123
1981 - 1,122
1980 - 1,169
1979 - 1,209
1978 - 1,223

QUALITY OF WATER -- Hardness 305-320 mg/L
Iron 1.9-2.3 mg/L
Diss. Solids 364-386 mg/L



Water levels in well 6S 6W 22CA at Coldwater. Well is 113 feet deep and in glacial deposits.

CALHOUN COUNTY - CITY OF BATTLE CREEK

SUPPLY AND SOURCE -- 29 wells, 110 to 152 feet deep, tap sandstones of Marshall Formation. All are located at the Verona Field.

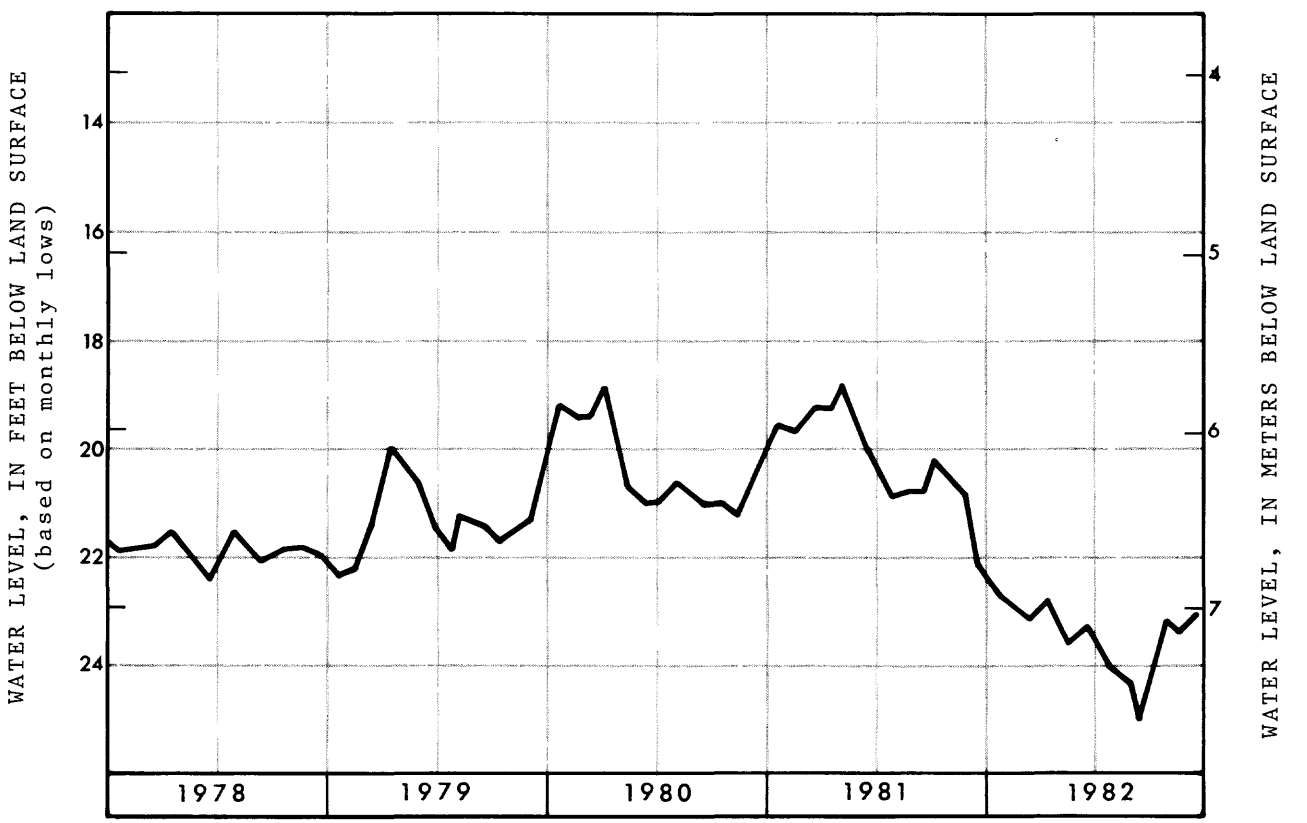
YIELD OF WELLS -- 300 to 1,000 gal/min; specific capacity -- 50 to 650 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982	3,590
1981	2,742
1980	2,836
1979	2,875
1978	2,659

QUALITY OF WATER --

Hardness	295-345 mg/L
Iron	0.05-1.3 mg/L
Diss. Solids	333-413 mg/L



Water levels in well 1S 7W 32BDCC1 at Battle Creek. Well is 95 feet deep and in Marshall Formation.

CLINTON COUNTY - CITY OF ST. JOHNS

SUPPLY AND SOURCE -- 7 wells, 420 to 525 feet deep, tap sandstones of Saginaw Formation.

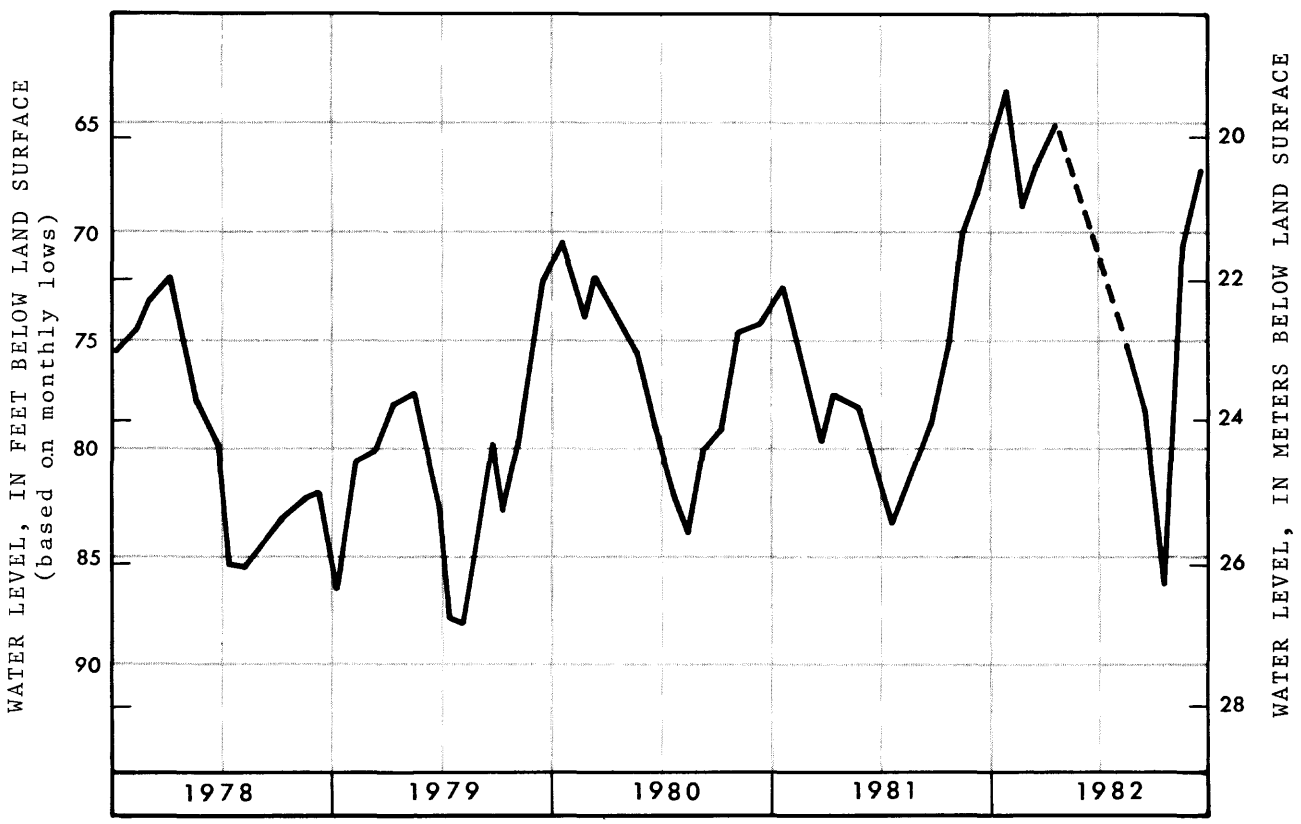
YIELD OF WELLS -- 250 to 500 gal/min; specific capacity -- 3 to 12 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

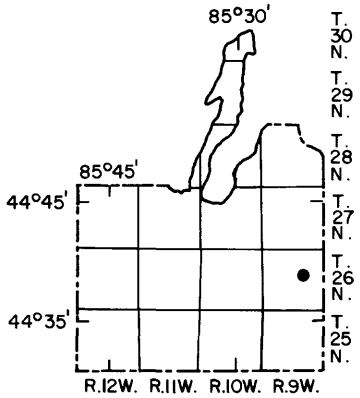
1982	414
1981	425
1980	423
1979	511
1978	529

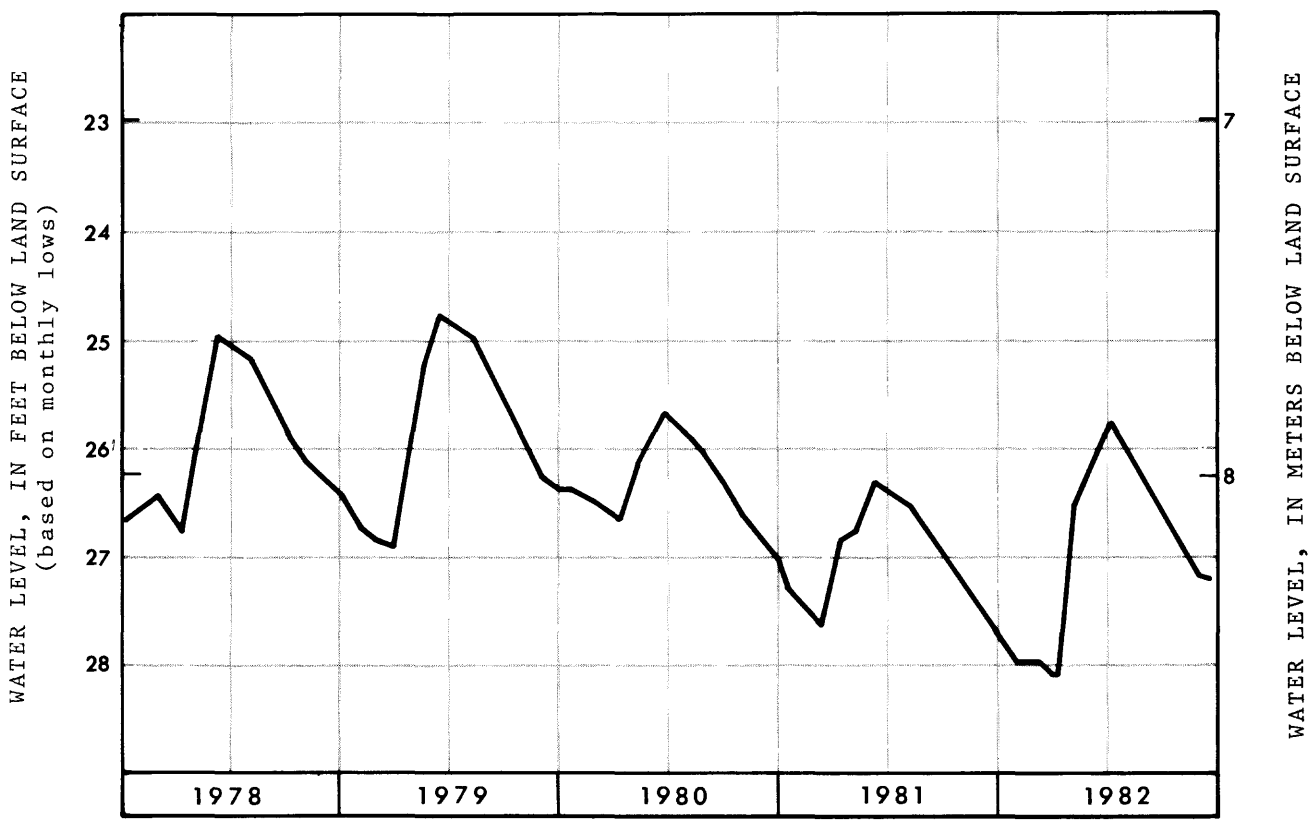
QUALITY OF WATER --

Hardness	260-310 mg/L
Iron	0.15-1.0 mg/L
Diss. Solids	360-390 mg/L

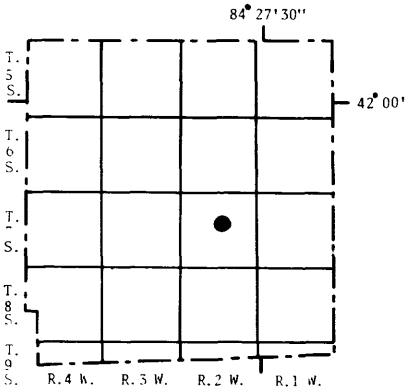


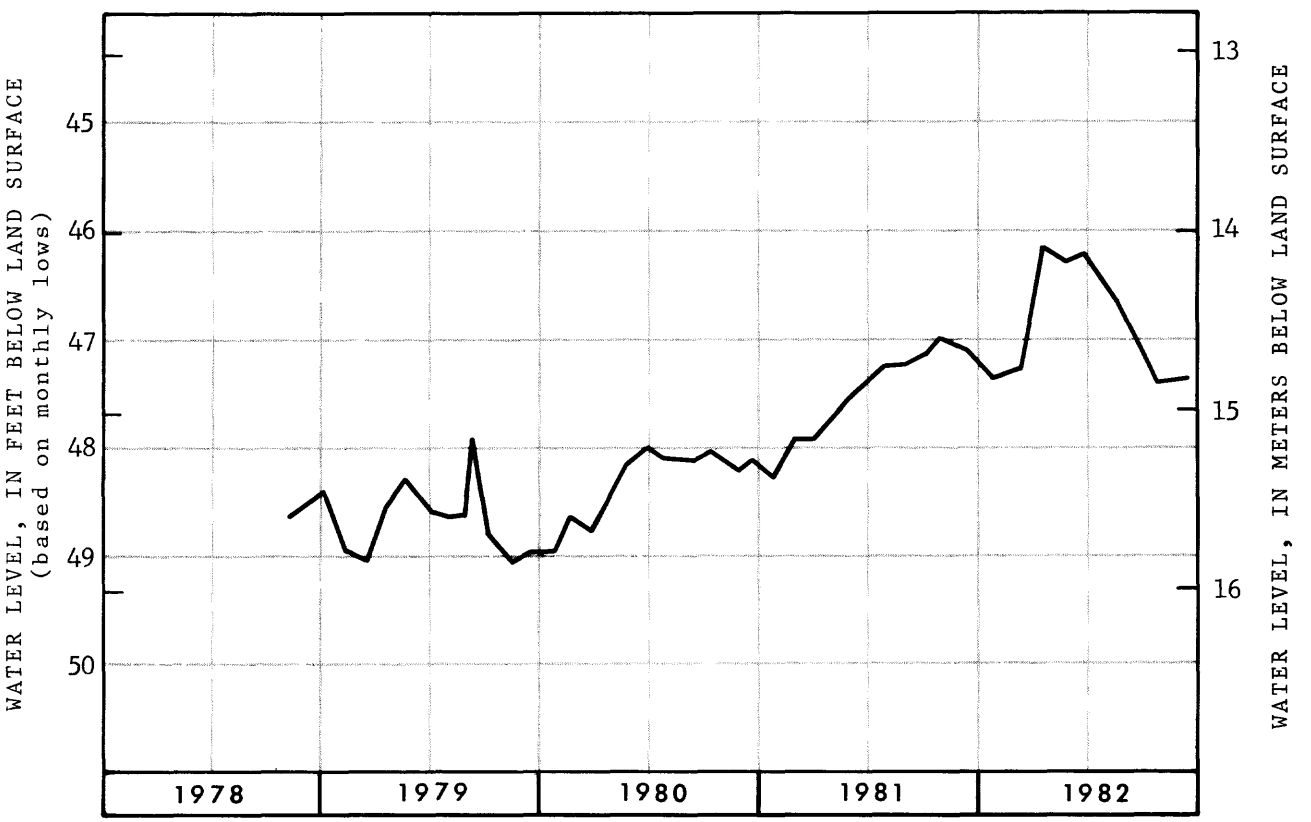
Water levels in well 7N 2W 9BB at St. Johns. Well is 535 feet deep and in Saginaw Formation.





Geological Survey well 26N 9W 14ABAA1. Well is 80 feet deep and in sand. Water-quality data in ground-water report for 1977 (Huffman, 1979).





Water levels in well 7S 2W 15BCBA1. Well is 150 feet deep and in glacial outwash. Water-quality data in ground-water report for 1979 (Huffman, 1980).

SUPPLY AND SOURCE -- 125 wells, 400 to 425 feet deep, tap sandstones of Saginaw Formation; 3 wells, 85 to 105 feet deep, tap sand beds in glacial deposits.

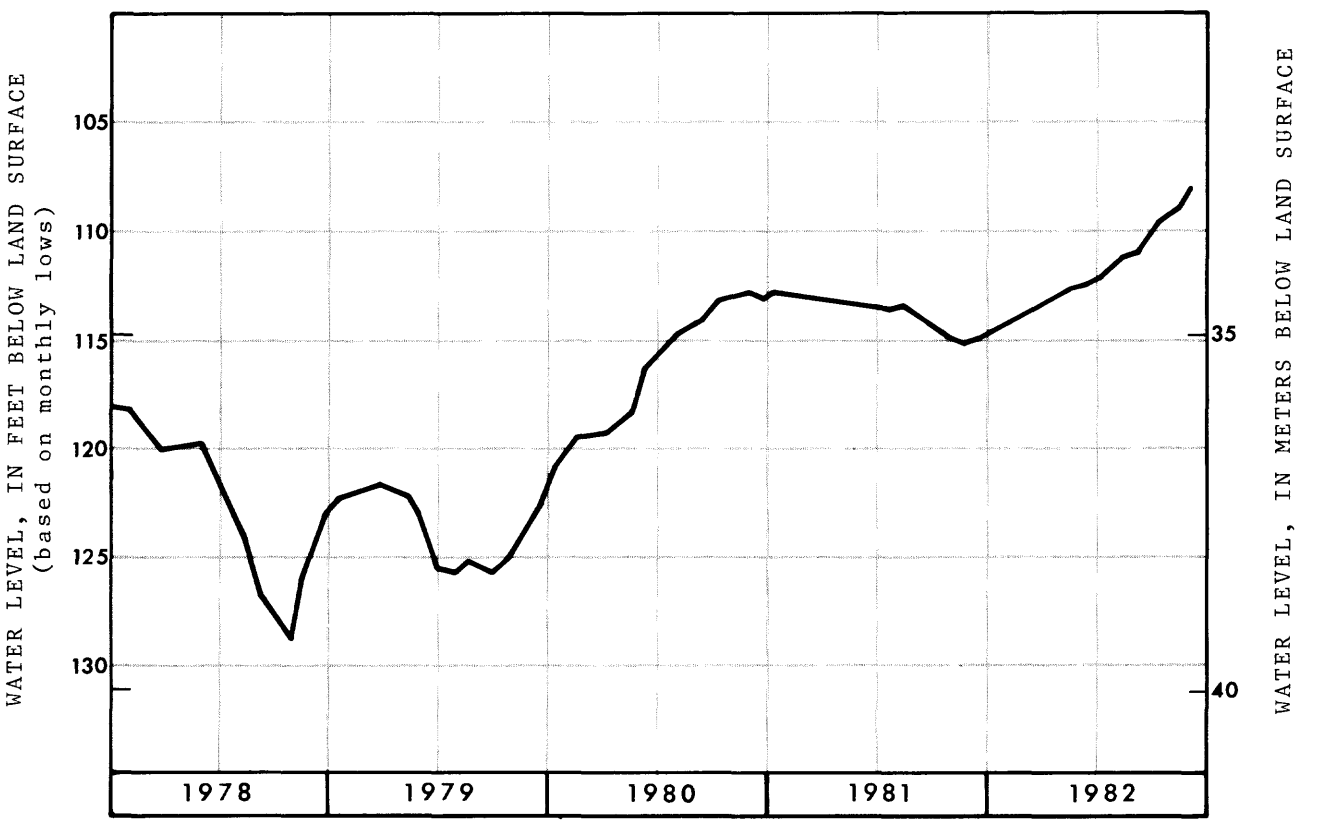
YIELD OF WELLS -- Sandstone - 100 to 700 gal/min; specific capacity --3 to 10 gal/min/ft of drawdown.
-- Glacial deposits - 790 to 1,200 gal/min, specific capacity -- 12 to 80 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982	8,182
1981	8,607
1980	8,592
1979	9,574
1978	9,308

QUALITY OF WATER -- Composite at Plant

Hardness	385 mg/L
Iron	0.88 mg/L
Diss. Solids	456 mg/L



Water levels in well 4N 2W 17AB at Lansing. Well is 424 feet deep and in Saginaw Formation.

INGHAM COUNTY - CITY OF MASON

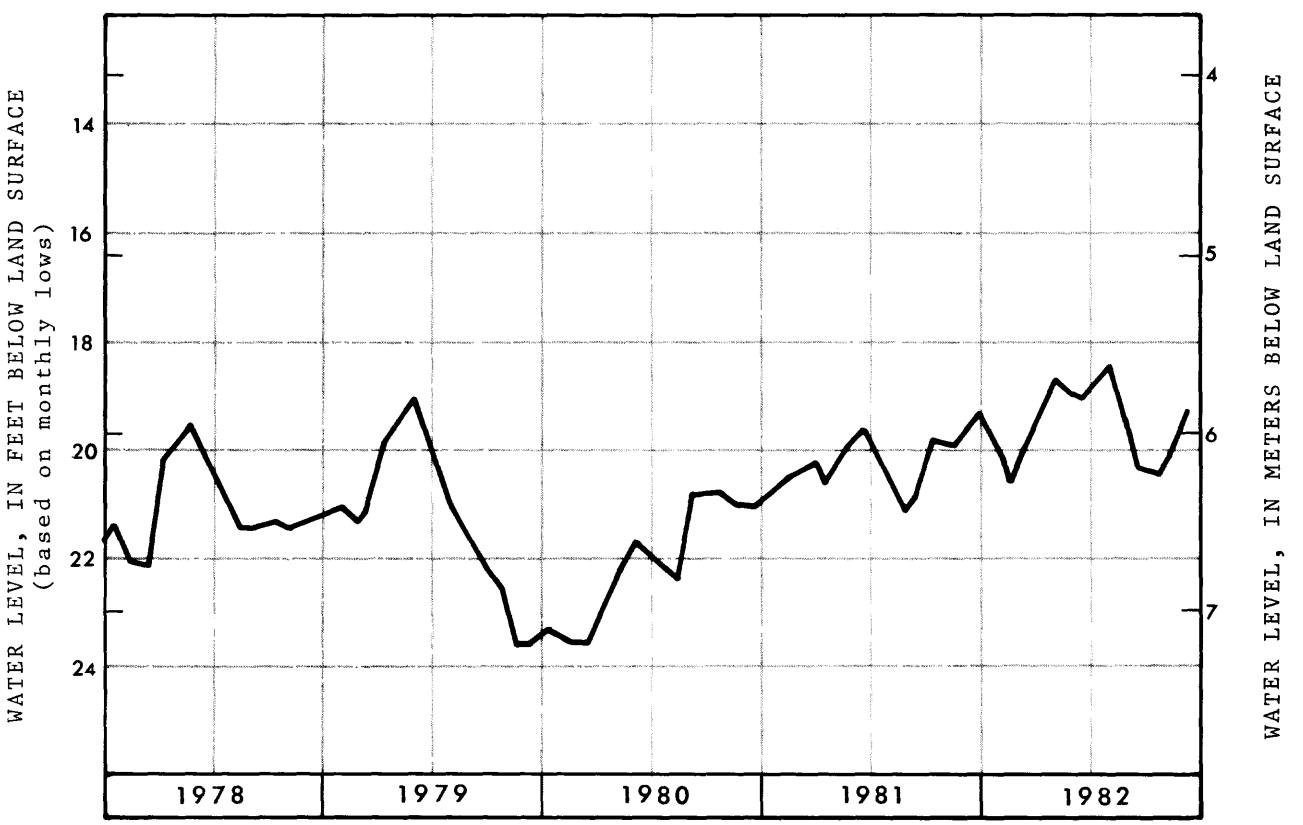
SUPPLY AND SOURCE -- 1 well, about 50 feet deep, taps glacial deposits; 1 well, 223 feet deep, taps sandstones of Saginaw Formation.

YIELD OF WELLS -- 675 to 700 gal/min; specific capacity -- No. 3 yields 30 gal/min/ft of drawdown from the glacial drift.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982 - 228
1981 - 233
1980 - 217
1979 - 230
1978 - 191

QUALITY OF WATER -- Hardness 335-464 mg/L
Iron 0.0-0.40 mg/L
Diss. Solids 353-497 mg/L



Water levels in well 2N 1W 5BCAB1 at Mason. Well is 210 feet deep and in Saginaw Formation.

KALAMAZOO COUNTY - CITY OF KALAMAZOO

SUPPLY AND SOURCE -- 84 wells, 130 to 254 feet deep, tap glacial deposits.

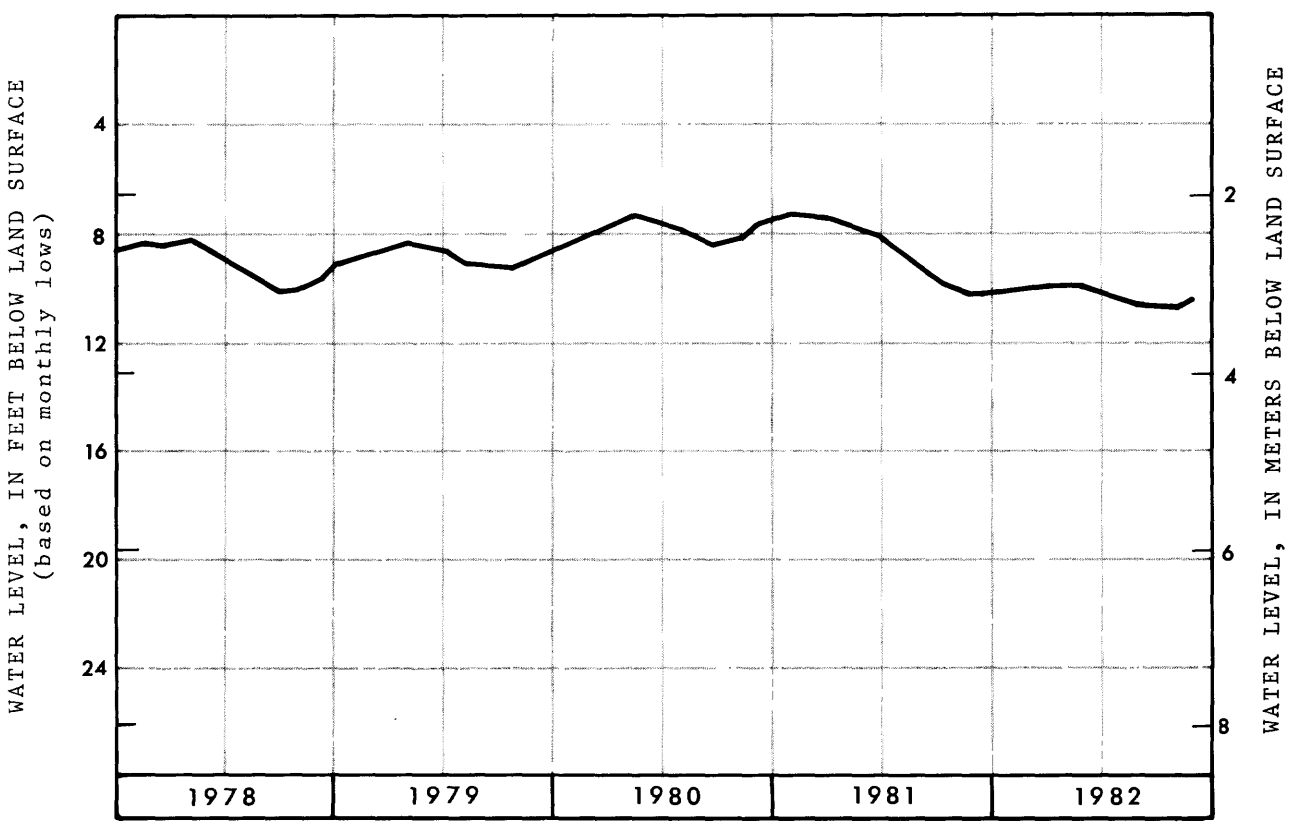
YIELD OF WELLS -- 200 to 2,000 gal/min; specific capacity -- 7 to 100 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982	5,772
1981	6,393
1980	5,774
1979	6,520
1978	6,551

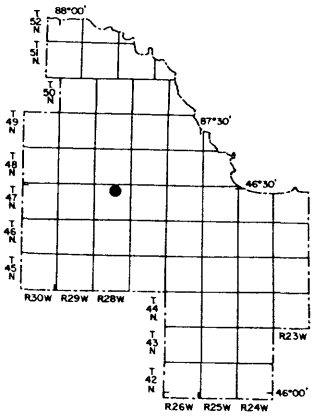
QUALITY OF WATER -- Composite of 2 pumping stations:

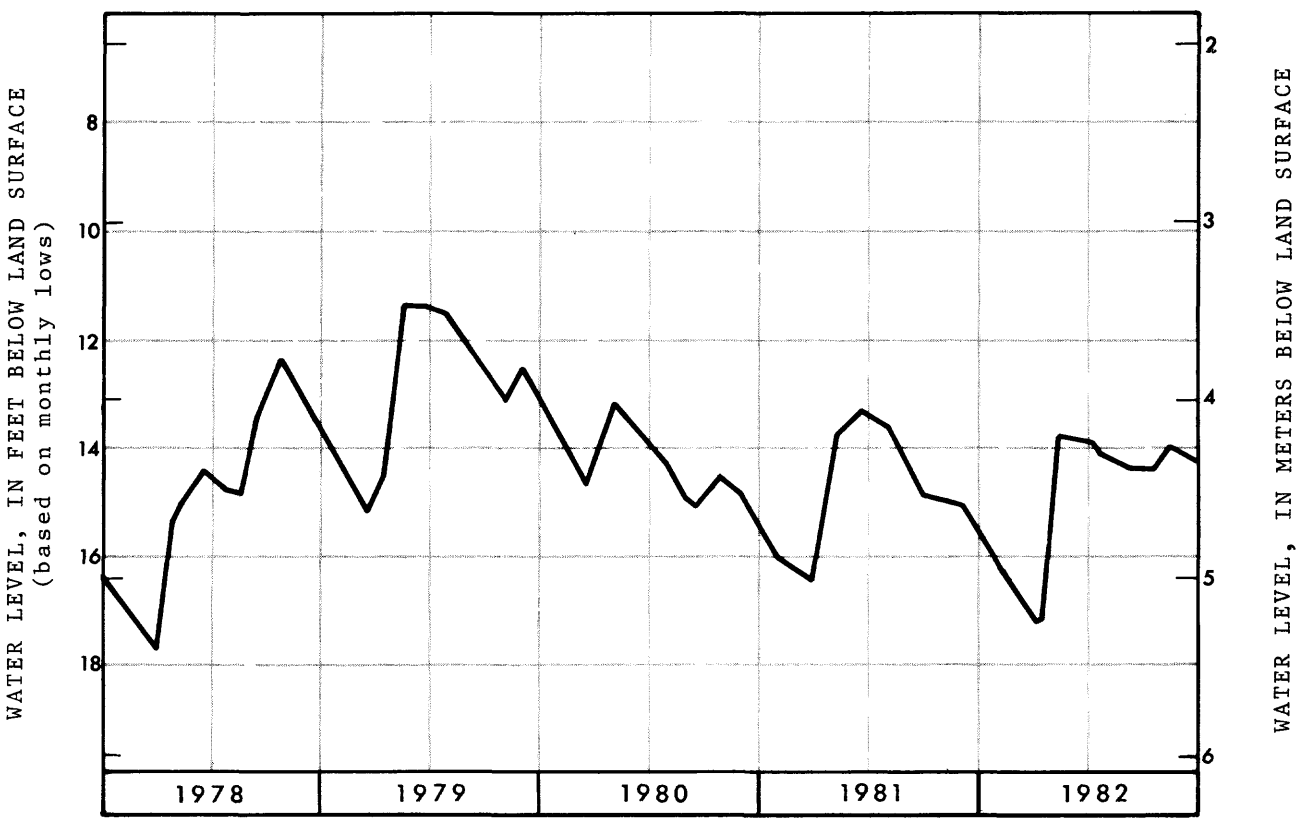
Hardness	385-420	mg/L
Iron	0.49-3.10	mg/L
Diss. Solids	499-530	mg/L



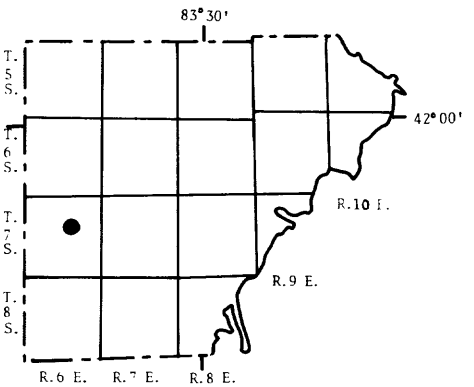
Water levels in well 2S 11W 22CD at Kalamazoo. Well is 137 feet deep and in outwash.

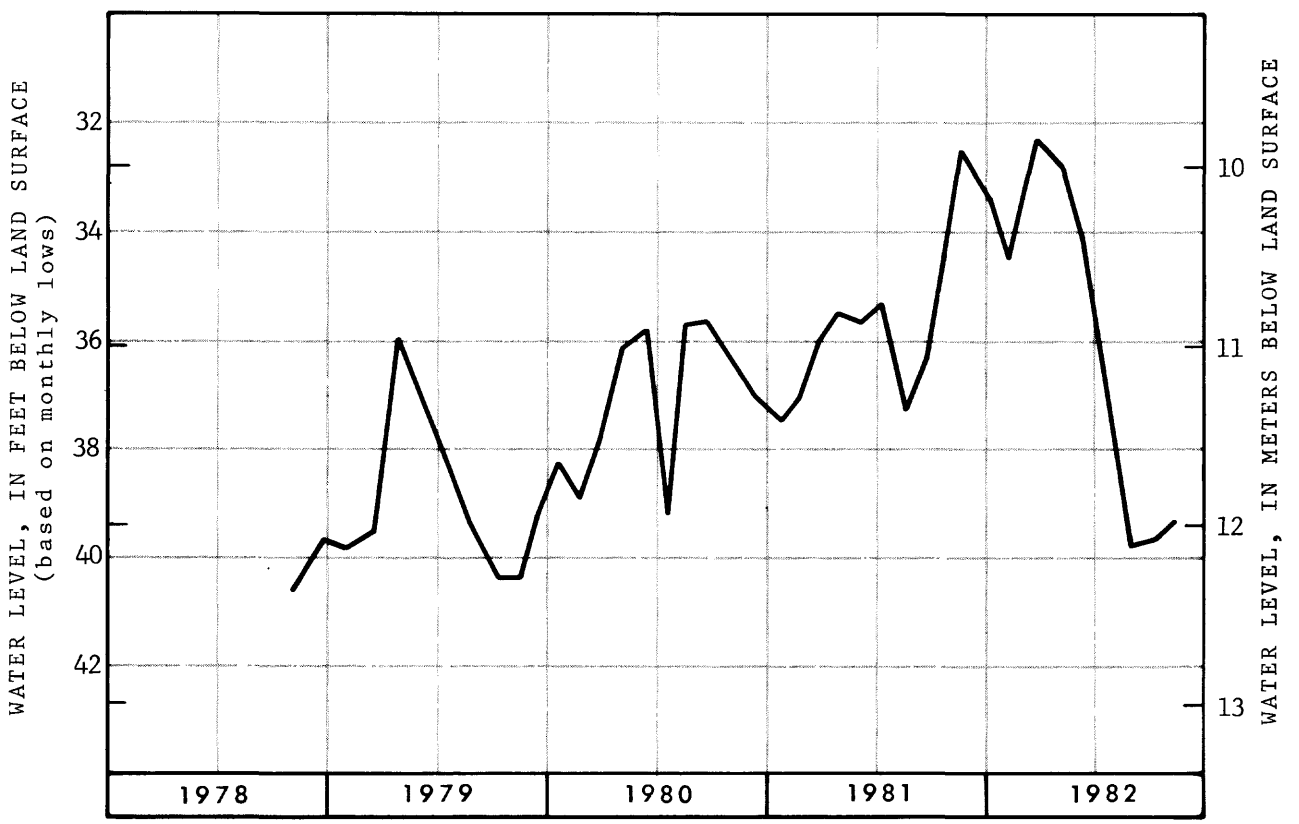
MARQUETTE COUNTY - IRON RANGE AREA



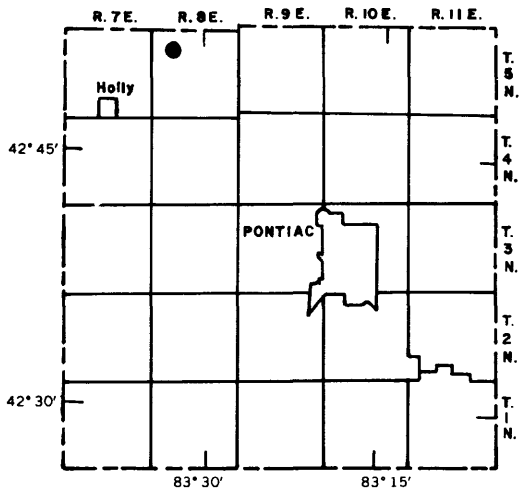


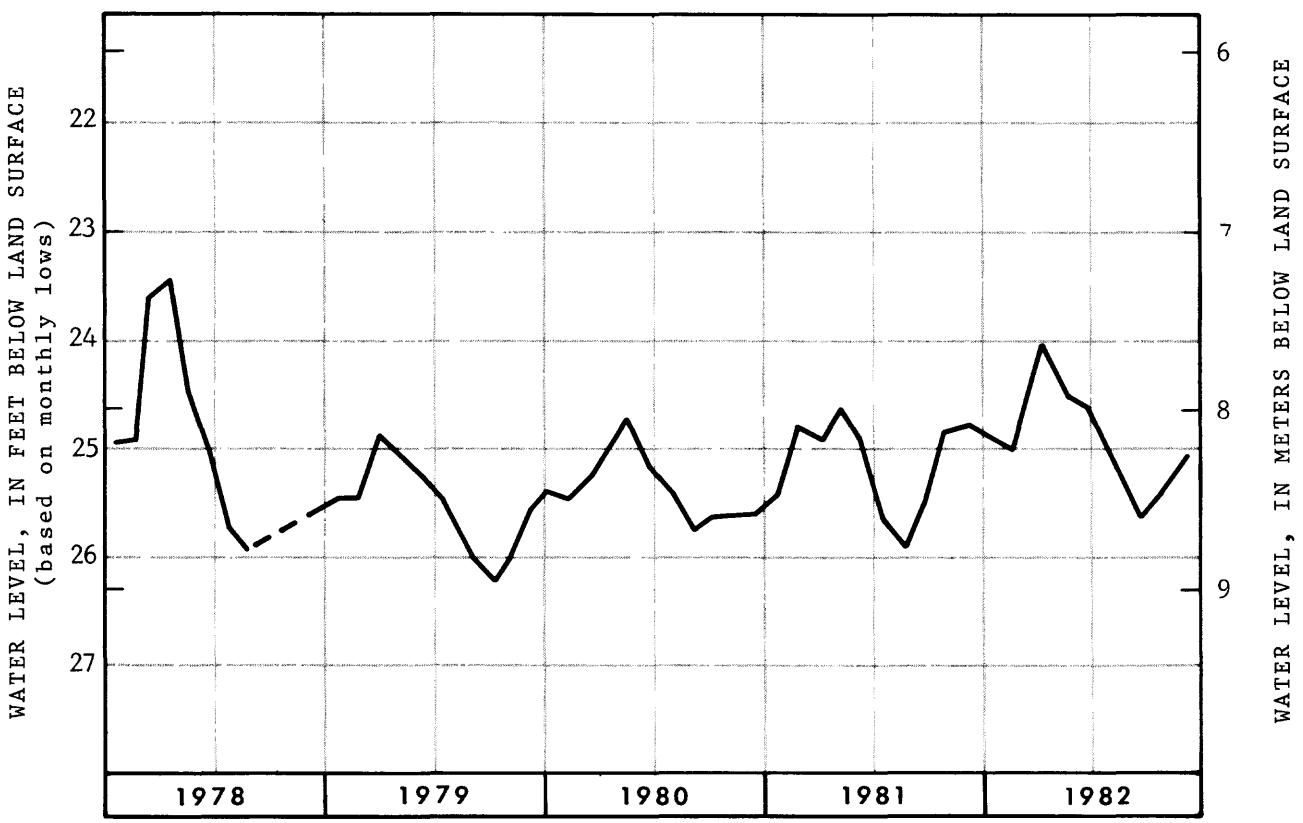
Water levels in well 47N 28W 3CCDC1. Well is 75 feet deep and in outwash. Levels are typical of observation wells in Marquette Iron Range.



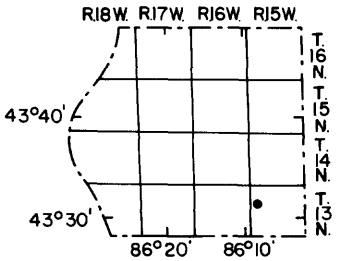


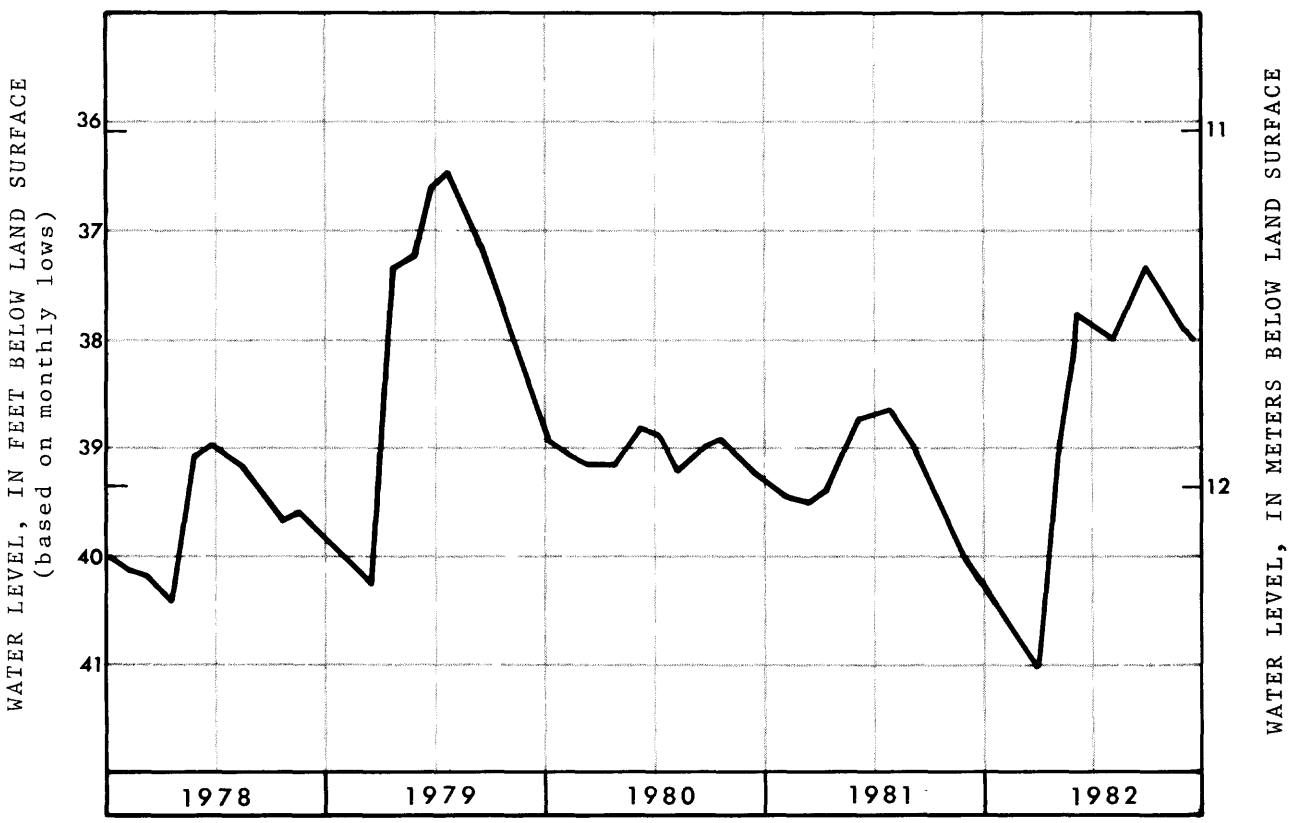
Water levels in well 7S 6E 15ACAA1. Well is 73 feet deep and in the Detroit River Group. Water-quality data in ground-water report for 1979 (Huffman, 1980).



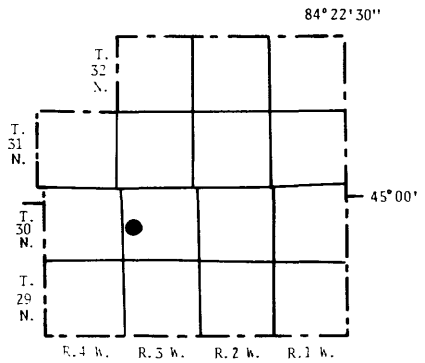


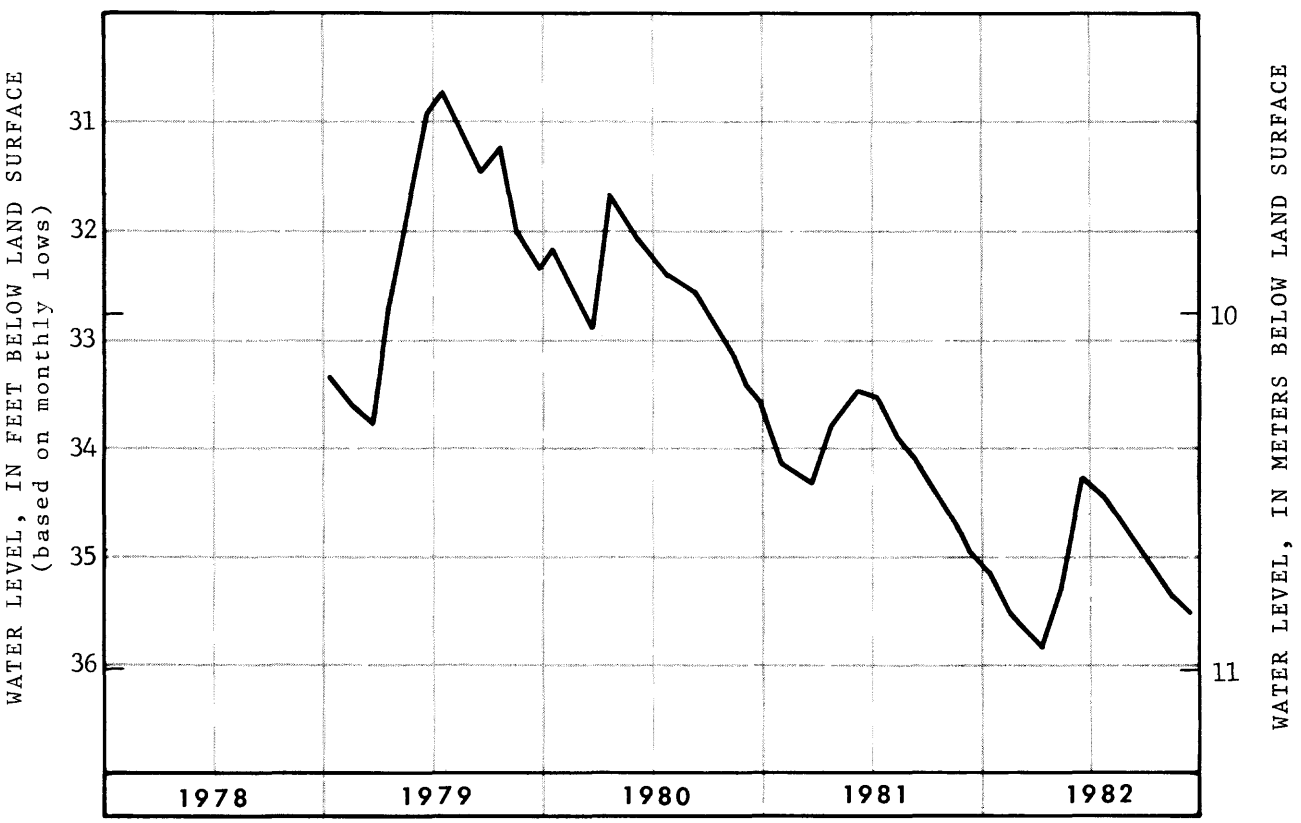
Water levels in well 5N 8E 8ACAC1. Well is 42 feet deep and in glacial deposits.





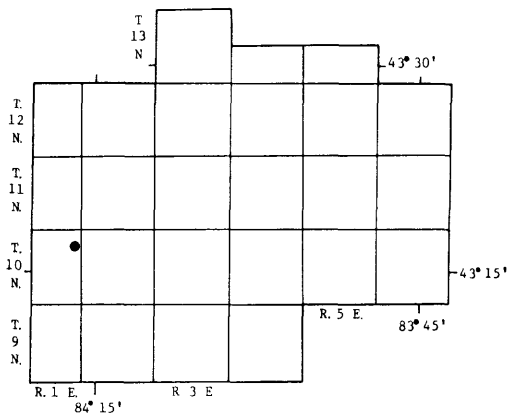
Geological Survey well 13N 15W 18AAAA1. Well is 79 feet deep and in outwash. Water-quality data in ground-water report for 1977 (Huffman, 1979).

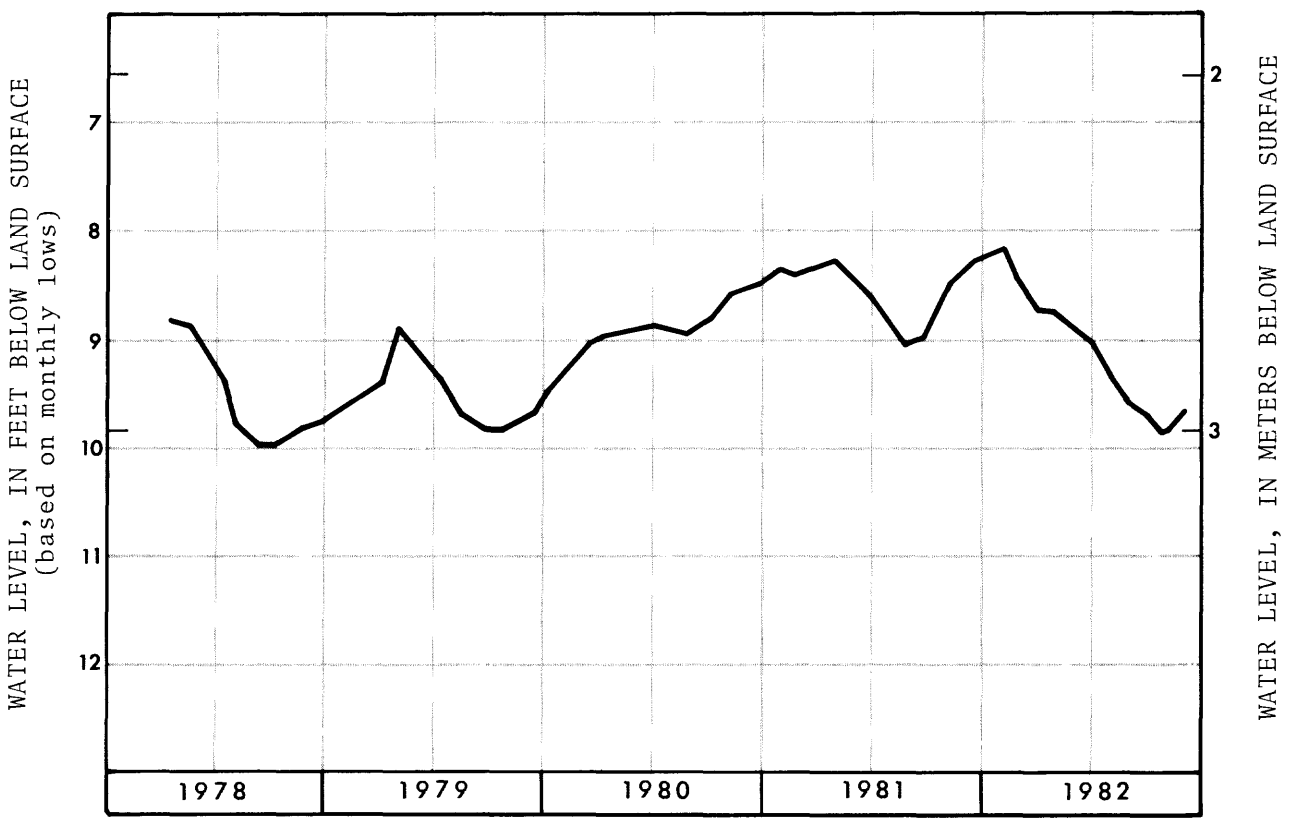




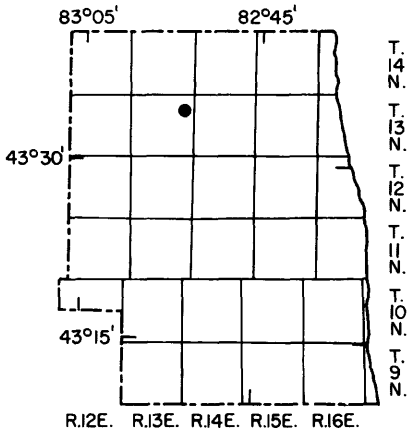
Water levels in well 30N 3W 19ABBB1. Well is 90 feet deep and in glacial outwash. Water-quality data in ground-water report for 1979 (Huffman, 1980).

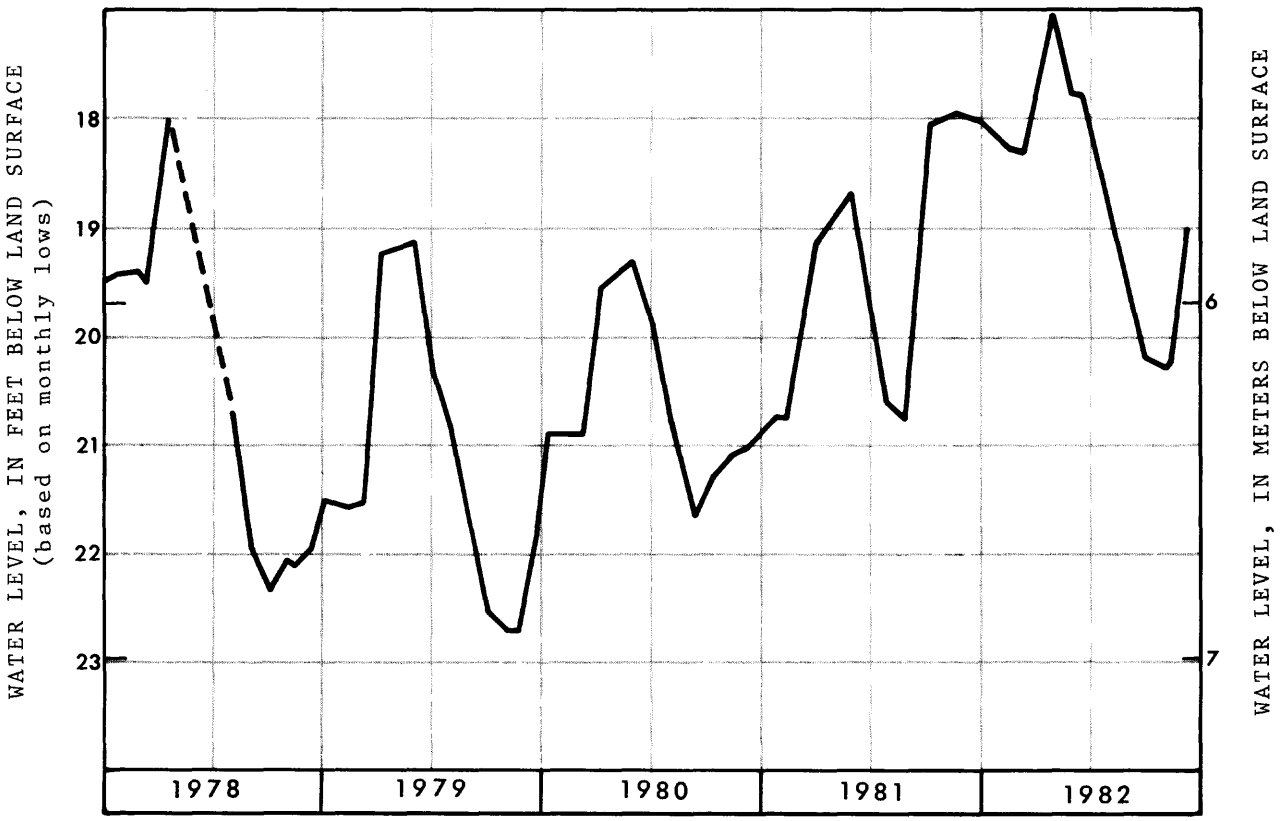
SAGINAW COUNTY





Water levels in well 10N 1E 12ADAA1. Well is 210 feet deep and in Saginaw Formation. Water-quality data in ground-water report for 1977 (Huffman, 1979).





Geological Survey well 13N 13E 12ADAA1. Well is 130 feet deep and in the Marshall Formation. Water-quality data in ground-water report for 1977 (Huffman, 1979).

WASHTENAW COUNTY - CITY OF ANN ARBOR

SUPPLY AND SOURCE -- 3 wells, 91 to 196 feet deep, tap glacial deposits; most water is pumped from the Huron River.

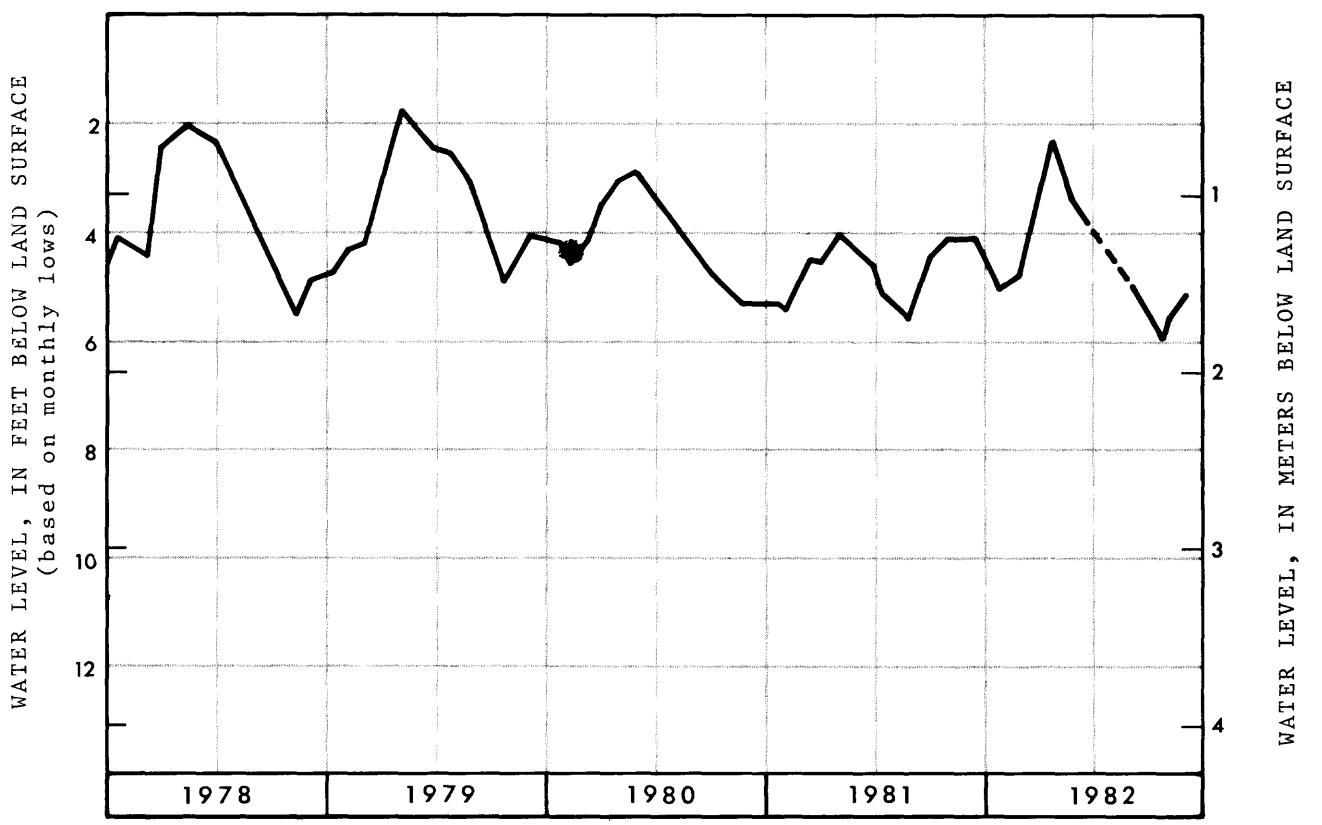
YIELD OF WELLS -- 1,050 to 4,860 gal/min; specific capacity -- 20 to 600 gal/min/ft of drawdown.

PUMPAGE -- Total annual ground-water pumpage, in million gallons, for past 5 years (ground water is used to augment supply from Huron River).

1982 - 720
1981 - 787
1980 - 742
1979 - 372
1978 - 705

QUALITY OF WATER -- Ground water:

Hardness	355-585 mg/L
Iron	0.25-2.4 mg/L



Water levels in well 3S 6E 16BCCD1 at Ann Arbor. Well is 55 feet deep and in glacial deposits.

WASHTENAW COUNTY - CITY OF YPSILANTI

SUPPLY AND SOURCE -- 6 wells, 87 to 102 feet deep, tap glacial deposits.

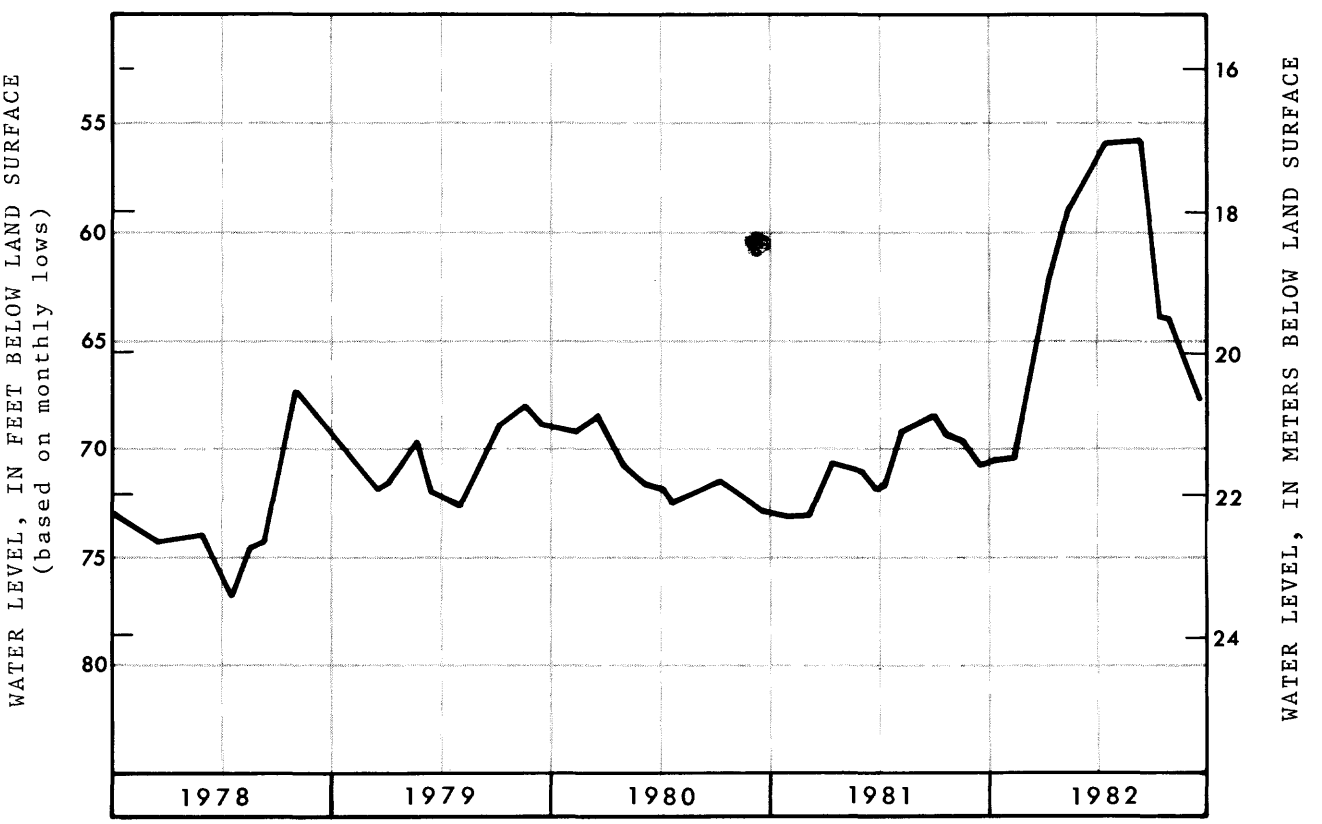
YIELD OF WELLS -- Average 450 gal/min; specific capacity -- 25 to 180 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1982	1,196
1981	1,385
1980	1,288
1979	1,140
1978	1,296

QUALITY OF WATER -- Composite

Hardness	355 mg/L
Iron	0.2 mg/L
Diss. Solids	475 mg/L



Water levels in well 3S 7E 9AD at Ypsilanti. Well is 94 feet deep and in glacial deposits.

TABLES

Table 1.--Records of Michigan observation wells

COUNTY AND WELL NUMBER: See section in text entitled "Well-numbering system".
NAME: MDNR - Michigan Department of Natural Resources; WMP - Wisconsin-Michigan Power Company; MSHD - Michigan State Highway Department; USFS - U.S. Forest Service.
AQUIFER:

112GLCL	Glacial deposits	337MRSL	Marshall Formation		
112GRVL	Gravel	341TRVR	Traverse Group	361OCVCU	Ordovician, Upper
112OTSH	Outwash	344DUND	Dundee Formation	365TBRV	Trenton-Black River Group
112SAND	Sand	348DRRV	Detroit River Group	368PRDC	Prairie du Chien Group
112SDGV	Sand and Gravel	355SLINH	Salina Formation	372MNSG	Munising Sandstone
324SGNW	Saginaw Formation	355MNSQ	Manistique Dolomite	420FRED	Freda Sandstone

ALTITUDE: Land-surface datum in feet above mean sea level.
MEASUREMENTS, 1982 (frequency); R - Continuous recorder; D - Daily; W - Weekly; M - Monthly; Q - Quarterly; S - Semiannually; A - Annually; I - Intermittent.
OBSERVED WATER-LEVEL EXTREMES: In feet below or above (+) land surface. 1982 measurements underscored are extremes for entire record.
REMARKS: P - Water levels affected by pumping. Water-level measurements are made by the U.S. Geological Survey unless otherwise noted.

COUNTY AND WELL NUMBER	NAME	DEPTH (FT)	DIAMETER (IN)	AQUIFER	ALTITUDE	YRS. RECORD	MEAS. 1982	OBSERVED WATER-LEVEL EXTREMES				REMARKS
								THROUGH 1981		IN 1982		
TWP, RANGE, SECT.								MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	
ALGER												
45N 19W 25BDCD1	CCC	66	6	112GLCL	850	24	Q	6.4 Jun 1960	14.2 Apr 1964	10.8 Jul	12.0 Apr	
ALPENA												
32N 6E 23DDDA1	Alpena State Forest	88	6	112SAND	713	6	R	15.8 May 1979	28.7 Mar 1977	21.4 Jul	30.0 Mar	
ARENAC												
19N 5E 7DABA1	Omer, D	185	6	324SGNW	667	3	M	8.3 Jul 1980	10.1 Aug 1980	9.1 Mar	9.7 Oct	
7DABA2	Omer, S	21	6	112GLCL	667	3	M	4.6 May 1981	6.9 Aug 1980	2.9 Jun	6.5 Mar	
BARAGA												
48N 32W 12DD	WMP 14	10	1	112GLCL	1,630	35	M	3.3 Apr 1965	8.1 Sep 1969	5.2 Apr	7.5 Jul	Meas. by WMP
BARRY												
4N 9W 5DA	Solomon Road	131	2	112GLCL	860	19	Q	111.5 Mar 1978	122.0 Mar 1965	116.1 Aug	116.7 Dec	
BAY												
17N 4E 22DCAA1	Pinconning Twsp.	110	6	324SGNW	620	21	M	0.0 Mar 1976	10.5 Aug 1963	1.4 Mar	2.7 Aug	
BRANCH												
6S 6W 18CCCD1	Coldwater Twsp.	56	6	112OTSH	950	19	M	18.3 Mar 1976	28.3 Jul 1964	20.9 Apr	23.1 Oct	
22CA	Coldwater Test 4	113	6	112GLCL	970	19	R	9.0 May 1975	25.9 May 1977	10.0 Jul	23.6 Sep	P
CALHOUN												
1S 7W 10BB	Sabin	12	15	112GLCL	908.0	37	W	0.9 Mar 1950	7.2 Dec 1964	2.6 Apr	4.6 Oct	Meas. by owner
32BDCC1	Penfield Twsp.	95	6	337MRSL	845	19	R	15.6 Apr 1974	27.0 Aug 1964	19.7 Dec	25.0 Sep	P
32DABD	Battle Creek	127	8	337MRSL	830.8	44	D	0.7 Apr 1950	16.8 Jul 1959	7.4 Dec	13.7 Aug	P, Meas. by owner
2S 6W 25AA	Marshall	59	6	337MRSL	904.8	33	M	5.5 May 1950	9.7 Aug 1964	6.3 Aug	8.1 Mar	P, Meas. by owner
CASS												
8S 14W 17BA	Little	55	28	112GLCL	840	38	M	46.2 Jul 1950	55.0 Mar 1957	47.4 Aug	49.4 Jan	
CHEBOYGAN												
33N 1W 26DABB1	Pigeon River CCC	164	6	112SAND	933	17	R	56.1 Jun 1979	59.9 Dec 1965	58.9 Jun	60.2 Jul	
39N 3W 29CBCB1	Mackinaw, D	125	6	344DUND	705	4	M	5.2 May 1979	11.7 Feb 1981	6.2 May	10.8 Aug	
29CBCB2	Mackinaw, S	55	6	112SDGV	705	4	M	2.1 May 1979	6.5 Feb 1981	2.5 Dec	5.7 Aug	
CHIPPEWA												
46N 4W 24DAAD1	Raco	54	6	112OTSH	850	30	R	18.4 Jun 1971	28.4 Apr 1964	23.8 Jun	27.4 Apr	
CLARE												
17N 4W 34DCAD	Clare	91	4	112GLCL	850	8	R	7.9 Mar 1976	24.9 May 1977	11.2 Jun	17.9 Jul	

Table 1.--Records of Michigan observation wells--Continued

COUNTY AND WELL NUMBER TWP, RANGE, SECT.	NAME	DEPTH (FT)	DIAMETER(IN)	AQUIFER	ALTITUDE	YRS. RECORD	MEAS. 1982	OBSERVED WATER-LEVEL EXTREMES				REMARKS
								THROUGH 1981		IN 1982		
								MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	
CLINTON												
5N 2W 31CBBA1	Capital City Airport	195	6	324SGNW	850	25	R	45.0 Mar 1949	66.4 Jan 1967	55.1 Dec	58.0 Feb	P
32DC	Quarantine Farm	135	4	324SGNW	849.2	39	M	42.0 Sep 1944	99.2 May 1966	76.4 Dec	82.0 Jan	P
6N 2W 16DDAD1	MSHD, U.S. 27	23	14	112GLCL	803.3	35	M	13.8 Apr 1974	19.9 Feb 1964	17.1 Apr	18.5 Oct	Federal key well
7N 1W 34CC	Sleepy Hollow 7	32	1	112OTSH	785.3	16	A	17.1 Mar 1973	20.3 Oct 1973	17.7 May		
2W 9BBCD	St. Johns	535	6	324SGNW	743.4	19	R	52.2 May 1967	93.7 May 1977	59.4 May	86.2 Nov	P
CRAWFORD												
25N 1W 15DDCD1	Eldorado	56	6	112GLCL	1,190	35	R	25.7 May 1976	36.0 Apr 1951	29.7 Jun	31.8 Apr	
DELTA												
39N 23W 28AC	Schemmel	530	5	372MNSG	680	25	R	1.3 May 1960	8.6 Feb 1977	4.8 Apr	6.0 Aug	
41N 18W 31CD	Isabella	250	5	361ODVCU	615	25	M	3.3 Sep 1979	6.4 Feb 1977	4.2 Mar	5.2 Feb	
42N 18W 17ABBD	Cooks CCC	60	6	112GLCL	760	21	Q	21.2 May 1960	28.4 Mar 1966	22.9 May	24.6 Feb	
42N 19W 20AA	Pollack CCC	134	6	112GLCL	740	25	Q	23.8 Mar 1960	28.1 Feb 1971	23.4 Jul	26.0 Feb	
43N 19W 24BB	Clarage	405	4	365TBRV	860	25	Q	77.0 Jul 1960	88.8 Oct 1966	79.4 Jul	80.5 Feb	
DICKINSON												
43N 28W 32ADAB1	Felch	31	1	112SAND	1,160	17	M	13.1 May 1972	16.8 May 1968	14.2 Jun	15.7 Feb	
EATON												
3N 3W 2BA	Lansing, Stiefel	66	1	112GLCL	839	19	R	3.1 Mar 1965	18.0 Nov 1968	4.2 Jan	11.9 May	P
4N 3W 12CD	Robins Road	381	6	324SGNW	861.9	30	R	67.5 Nov 1953	103.6 Aug 1969	79.7 Apr	95.8 Aug	P
GENESEE												
6N 7E 9DCCC1	Fisher Body No. 2	385	10	324SGNW	837.0	10	R	52.3 Dec 1975	87.0 Jun 1977	55.6 Jan	73.8 Aug	P
GRAND TRAVERSE												
26N 9W 14ABAA1	Fife Lake State Forest	80	6	112SAND	960	6	R	24.3 Sep 1976	27.6 Dec 1981	25.5 Jun	28.0 Mar	
HILLSDALE												
7S 2W 10BDDD1	Pittsford Game Area	20	1	112SAND	1,070	17	M	7.0 May 1978	11.1 Sep 1967	5.8 Apr	8.4 Oct	
2W 15BCBA1	Osseo	150	6	112OTSH	1,095	4	M	47.0 Oct 1981	49.0 Dec 1979	46.1 Apr	47.4 Oct	
INGHAM												
2N 1E 34DB	Dansville Game Area	87	2	112GLCL	930	19	Q	22.4 Apr 1974	29.3 Oct 1964	23.0 Apr	25.4 Sep	
2N 1W 5BCAB1	Mason	210	8	324SGNW	890	19	R	14.7 Mar 1973	23.8 Nov 1964	17.2 Jul	20.6 Feb	P
3N 1E 7DDCA1	Lotte	184	3	324SGNW	900	19	M	+2.4 Apr 1974	7.0 Nov 1964	+0.73 Apr	2.1 Oct	
2W 23BCBD	Holt	188	8	324SGNW	895	1	R			18.5 Apr	22.5 Oct	
4N 1W 16DA	Meridian Twsp.	398	4	342SGNW	841.2	15	M	6.3 Mar 1976	17.3 Aug 1981	11.2 Apr	14.8 Jul	P
28BCAD1	Okemos	125	4	324SGNW	865	7	R	18.1 May 1976	24.2 Sep 1978	19.4 Apr	22.7 Aug	
4N 2W 16DA	Lansing, Cedar	417	12	324SGNW	829.1	38	R	42.0 Mar 1946	67.0 Aug 1949	44.1 Dec	53.1 Feb	P
17AB	Lansing, Logan	424	20	324SGNW	858.7	52	R	34.3 Dec 1929	168.3 May 1968	104.4 Dec	115.1 Jan	P
21BA3	Lansing, Scott Park	400	4	324SGNW	835	4	R	47.6 Nov 1980	58.8 Jun 1979	45.6 Dec	53.6 Jan	P
22BC	Lansing, P-5	338	12	324SGNW	823.6	53	M	7.1 Jul 1932	80.5 Feb 1970	50.3 May	61.8 Feb	P
24CA	Spartan Village	453	10	324SGNW	853.4	38	R	25.5 Mar 1946	105.5 May 1972	74.9 Dec	92.4 Feb	P
27BB	Fenner Arboretum	215	6	324SGNW	835	15	R	52.0 Jul 1968	89.5 Oct 1972	56.5 Dec	74.5 Jan	P
31CC	Maybell Street	204	3	324SGNW	880.2	39	M	18.9 Apr 1952	45.9 Jul 1980	39.8 Jan	44.3 Feb	P

Table 1.--Records of Michigan observation wells--Continued

COUNTY AND WELL NUMBER TWP, RANGE, SECT.	NAME	DEPTH (FT)	DIAMETER(IN)	AQUIFER	ALTITUDE	YRS. RECORD	MEAS. 1982	OBSERVED WATER-LEVEL EXTREMES				REMARKS
								THROUGH 1981		IN 1982		
								MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	
IOSCO												
24N 7E 13ADAD1	Oscoda	69	6	112SAND	760	3	M	30.2 Jul 1980	32.1 Apr 1981	31.6 Jul	32.7 Mar	
IRON												
43N 35W 11AD	WMP 23	47	36	112GLCL	1,565	38	M	35.5 Jul 1973	47.1 Aug 1949	38.2 Nov	39.6 May	Meas. by WMP
20DC	WMP 25	48	1	112GLCL	1,560	38	M	40.7 Jun 1973	48.3 Aug 1949	42.6 Dec	43.2 Mar	Do.
44N 37W 14BB	CCC Camp	102	6	112GLCL	1,730	24	Q	91.8 Oct 1973	96.7 Oct 1977*	93.0 Jun	97.1 Aug	*Revised 1981
JACKSON												
3S 1W 11AA1	Jackson, 4a Belden	360	6	324SGNW, 337MRSL	935	25	D	18.6 Jan 1961	119.1 Jun 1971	51.6 Dec	91.9 Aug	P, Meas. by owner
KALAMAZOO												
2S 10W 4D	Kalamazoo, Campbell	13	4	112OTSH	836.5	14	M	1.9 Apr 1974	6.8 Oct 1981	5.2 Apr	7.7 Oct	P
9B	Kalamazoo, Schoonover	21	6	112OTSH	828	14	R	+1.0 Apr 1975	4.0 Sep 1981	0.9 Apr	3.3 Oct	P
11W 20BB2	Kalamazoo, Kendall	106	4	112OTSH	880	15	R	12.5 Feb 1976	48.4 Jun 1971	17.0 Jun	40.6 Aug	P
22CD	Kalamazoo, Stockbridge	137	4	112OTSH	764.7	23	R	4.8 Feb 1975	31.1 Aug 1961	9.8 Apr	10.7 Oct	P
28AA	Kalamazoo, Maple	245	4	112OTSH	820	14	R	32.9 Jan 1979	61.6 Jun 1973	34.1 Feb	39.3 Jul	P
31CD	Kalamazoo, Colony	226	4	112OTSH	910	14	R	51.1 Jun 1974	71.8 May 1978	41.4 Sep	51.9 Oct	P
36CB	Kalamazoo, Emerald	226	4	112OTSH	860	14	R	25.7 May 1976	50.4 Jun 1971	26.2 Jul	39.6 Aug	P
3S 11W 4AD1	Kalamazoo, A-D	135	3	112OTSH	854.0	24	R	0.5 May 1967	12.9 Jul 1964	1.0 May	8.9 Apr	P
4AD2	Kalamazoo, A-S	40	3	112OTSH	854.0	24	R	+0.2 Sep 1975	9.1 Nov 1959	0.3 Jul	2.4 Apr	P
14AA	Upjohn 28	233	16	112OTSH	870	16	R	25.2 Feb 1976	45.2 Jul 1977	23.5 Aug	41.3 Mar	P
22BBCD	Portage	102	12	112GLCL	877	1	R			25.5 Jun	27.3 Oct	Rec. started 6-82
22BDB	Portage, C	120	8	112OTSH	865	16	R	5.9 Jun 1967	10.2 Nov 1976	7.2 Apr	9.0 Feb	P, Disc. 5-82
12W 11BD	Kalamazoo, Atwater	248	3	112OTSH	880	22	R	+3.0 Sep 1969	1.0 Aug 1977	+0.8 Apr	0.0 Aug	P
11AD1	Kalamazoo, Sabo-D	300	4	112OTSH	877	10	R	4.5 Jul 1973	16.4 Jul 1977	7.0 May	14.6 Apr	P
11AD2	Kalamazoo, Sabo-S	38	6	112OTSH	877	10	R	9.1 Aug 1975	12.7 Aug 1977	10.6 Apr	11.9 Aug	P
4S 11W 3CDDA1	Prairie View Park	190	4	112OTSH	870	14	R	18.2 Apr 1979	20.6 Dec 1977	18.1 Apr	19.7 Oct	
KENT												
5N 12W 4DCCD1	Wyoming, Wobma	86	6	112GRVL	868.0	21	M	7.8 Oct 1978	12.9 Aug 1964	9.3 Apr	10.7 Nov	
12W 17AD1	Alloytek	30	12	112GLCL	606	33	M	6.8 Apr 1965	16.4 Feb 1954	7.2 Apr	12.5 Feb	P, Meas. by owner Disc. 6-82
10N 12W 13DD	Rogue River Game Area	30	1	112GLCL	785	17	Q	0.8 Jan 1975	9.2 Oct 1969	1.1 Apr	7.3 Oct	
LAKE												
20N 13W 13ACAC1	Irons	57	6	112OTSH	945	3	M	14.7 Jul 1980	17.4 Dec 1981	15.4 May	18.0 Mar	
LEELANAU												
28N 14W 8DDCA1	Sleeping Bear, D	138	6	112SAND	750	3	M	113.1 Mar 1980	113.7 Aug 1981	113.9 Jan	114.2 May	
28N 14W 18BABB1	Sleeping Bear, S	60	6	112SAND	625	3	R	23.1 Apr 1981	24.5 Oct 1981	22.9 Apr	24.9 Nov	
LENAWEE												
5S 1E 12DDBD1	Onsted Game Area	39	1	112GLCL	1,000	17	M	16.1 May 1975	19.3 Sep 1971	15.9 Mar	17.5 Aug	
6S 4E 8DDBA1	Fisher Body	81	8	112OTSH	800	18	R	11.0 Nov 1981	18.4 Feb 1965	9.9 Apr	12.5 Dec	

Table 1.--Records of Michigan observation wells--Continued

COUNTY AND WELL NUMBER TWP, RANGE, SECT.	NAME	DEPTH (FT)	DIAMETER(IN)	AQUIFER	ALTITUDE	YRS. RECORD	MEAS. 1982	OBSERVED WATER-LEVEL EXTREMES				REMARKS
								THROUGH 1981		IN 1982		
								MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	
LIVINGSTON												
1N 6E 13DBAB1	American Aggregate	29	2	112OTSH	930	13	R	12.1 Apr 1974	21.6 Oct 1979	13.5 May	15.8 Dec	
2N 6E 31BA2	Brighton	83	10	112GLCL	935	9	R	27.2 Sep 1975	58.6 Jul 1978	29.2 Jan	50.2 Jul	P
MACKINAC												
41N 5W 23BC	Round Lake CCC	47	6	355SLINH	610	27	Q	4.3 May 1959	17.8 Feb 1981	10.0 Oct	16.7 Jan	
42N 2W 7AABB1	Pontchartrain CCC	102	6	355MNSQ	680	27	R	13.1 May 1960	32.3 Feb 1977	16.0 Apr	29.2 Mar	
MARQUETTE												
47N 25W 20CC	East Cascade Junction	103	1	112GLCL	1,229.8	20	M	78.5 Oct 1973	90.6 Jun 1965	83.3 Feb	84.8 Aug	Disc. 12-82
28W 3CCDC1	Ely Twsp.	75	8	112OTSH	1,572.0	22	R	9.7 May 1973	19.3 Apr 1964	13.1 May	17.2 Mar	Federal key well
48N 29W 30CC	Van Riper Park	78	6	112GLCL	1,560	14	M	9.6 May 1973	15.7 Feb 1977	11.4 May	13.7 Jan	
49N 30W 22AC	WMP 13	17	1	112GLCL	1,680	35	M	0.6 May 1951	13.3 Sep 1948	2.2 Apr	10.1 Jun	Meas. by WMP
MENOMINEE												
37N 26W 19DADA1	Carney	17	4	365TBRV	800	24	Q	3.5 Apr 1979	8.6 Jan 1977	4.2 Mar	5.2 Jun	
MONROE												
7S 6E 15ACAA1	Petersburg, rock	73	6	348DRRV	680	4	M	32.6 Nov 1981	40.2 Nov 1979	32.3 Mar	39.8 Aug	
15ADBB1	Petersburg Game Area	17	1	112GLCL	675	17	M	3.0 Feb 1966	6.8 Nov 1978	4.0 Mar	6.3 Oct	
MUSKEGON												
11N 15W 34ADDD1	Muskegon Game Area	31	1	112SAND	595	17	Q	+0.2 Apr 1978	4.7 Sep 1972	0.1 Apr	2.3 Jul	
OAKLAND												
2N 7E 5BA	Honeywell Lake Road	44	2	112GLCL	1,020	15	R	23.9 Apr 1976	28.9 Dec 1971	25.9 May	27.2 Nov	
8E 18DBAD1	Proud Lake Park	45	6	112OTSH	910	14	R	2.8 May 1974	6.4 Sep 1971	3.5 Apr	5.3 Oct	P
3N 7E 5DA	Fish Lake Road	49	2	112GLCL	1,055	14	R	29.5 Jun 1976	38.7 Dec 1972	32.3 Jul	35.7 Mar	
10E 13AC	Oakland University	183	6	112GLCL	940	2	R	56.9 Feb 1978	93.5 Jul 1963	56.6 Dec	60.0 Apr	
5N 8E 8ACAC1	Holly Recreation Area	42	1	112GLCL	930	17	M	22.3 Apr 1974	26.5 Sep 1966	24.1 Apr	25.6 Sep	
OCEANA												
13N 15W 18AAAA1	Hesperia	79	6	112OTSH	703	5	R	36.6 Jun 1979	40.4 Apr 1978	37.2 Sep	41.0 Mar	
OGEMAW												
23N 1E 2BAAA1	Rose City Road, D	105	1	112GLCL	1,265	15	Q	73.6 Oct 1976	78.2 Apr 1969	76.1 Apr	77.5 Oct	
2BAAA2	Rose City Road, S	20	1	112SAND	1,265	15	Q	7.6 Apr 1976	13.6 Dec 1972	10.4 Apr	12.3 Jan	
ONTONAGON												
46N 38W 30ADDD1	USFS	65	1	112SDGV	1,530	16	M	16.0 Jun 1973	19.7 Mar 1978	16.0 Jul	18.3 Mar	
51N 41W 8BDBC1	Silver City	100	6	420FRED	620	25	Q	8.2 Apr 1959	21.8 Dec 1976	8.8 Apr	11.2 Jan	
OTSEGO												
30N 3W 19ABBB1	Gaylord	90	6	112OTSH	1,308	4	M	30.7 Jul 1979	34.9 Dec 1981	34.2 Jun	35.8 Apr	

Table 1.--Records of Michigan observation wells--Continued

COUNTY AND WELL NUMBER	NAME	DEPTH (FT)	DIAMETER (IN)	AQUIFER	ALTITUDE	YRS. RECORD	MEAS. 1982	OBSERVED WATER-LEVEL EXTREMES				REMARKS
								THROUGH 1981		IN 1982		
TWP, RANGE, SECT.								MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	
PRESQUE ISLE												
33N 6E 8BBBB1	Styma	61	6	341TRVR	800	24	Q	5.1 Mar 1979	18.8 Mar 1963	8.7 May	16.7 Feb	
ROSCOMMON												
24N 2W 20BABA1	Exp. Station	14	8	112OTSH	1,145.3	49	R	2.1 Apr 1976	6.2 Dec 1949	3.3 Apr	5.5 Mar	Federal key well
SAGINAW												
10N 1E 22DADA1	Marion Springs, D	210	6	324SGNW	657	5	R	7.9 Feb 1981	10.0 Sep 1978	8.1 Feb	9.8 Oct	
SANILAC												
13N 13E 12ADAA1	Minden Game Area	130	6	337MRSL	805	6	R	17.4 Dec 1981	22.7 Oct 1979	16.4 Apr	20.3 Oct	
SCHOOLCRAFT												
45N 13W 16CCCB1	Seney	154	4	361ODVCU	710	31	R	4.6 Apr 1971	6.5 Oct 1963	5.0 Mar	5.8 Jun	
47N 16W 30BBBB1	Cusino CCC	57	6	368PRDC	900	26	R	5.7 May 1960	16.4 Feb 1977	7.2 Apr	15.8 Mar	
VAN BUREN												
2S 13W 2BBCD2	Almena, S	44	4	112GLCL	737	2	M	9.8 Feb 1981	12.0 Sep 1981	9.0 Mar	12.0 Oct	
14W 6BA	Martin	59	1	112GLCL	740	20	M	37.2 May 1974	43.3 Nov 1964	37.7 Apr	39.7 Feb	Disc., 7-82
WASHTENAW												
2S 3E 9DAAB2	Waterloo Park	48	6	112SDGV	970	14	R	4.1 May 1974	7.0 Aug 1971	4.3 Mar	6.4 Oct	P
3S 6E 16BCCD1	Ann Arbor	55	10	112GLCL	821.5	20	R	0.7 Mar 1974	15.9 Oct 1964	1.7 Apr	6.0 Oct	P
7E 5BB	Ypsilanti, Superior	69	8	112GLCL	720	21	R	1.8 Feb 1965	21.4 Dec 1965	3.2 Apr	14.0 Feb	P
9AD	Ypsilanti, Gilbert	94	6	112GLCL	710	32	R	29.1 Nov 1945	78.8 Oct 1974	54.7 Jul	70.3 Feb	P
24CA1	Ypsilanti Twsp. 104	87	4	112GLCL	665.6	37	R	5.8 Jan 1950	22.7 Feb 1971	12.4 Nov	14.9 Jan	P
24CD	Ypsilanti Twsp. 117	75	6	112GLCL	657.8	36	R	4.7 Oct 1981	63.2 Feb 1970	4.7 Mar	10.4 Jan	P
WEXFORD												
22N 12W 13BA	Harrietta Fish Hatchery	141	4	112GLCL	1,060	22	R	+13.8 Mar 1970	1.6 Jan 1981	+9.2 Jul	+3.6 Feb	P

Table 2.--Reported ground-water pumpage
(in millions of gallons)

COUNTY AND WATER USER	1982 TOTAL	MAX DAY	MIN DAY
ALCONA			
Harrisville	23.6	.102	.029
ALGER			
Burt Twp.	46.0	.318	.054
Chatham	8.0	--	--
ALLEGAN			
Allegan	381.4	1.700	.481
Douglas	66.2	--	--
Fennville	260.4	--	--
Otsego	391.5	1.512	.613
Plainwell	191.0	1.228	.279
Saugatuck	89.4	--	--
ANTRIM			
Bellaire	60.9	.313	.127
Central Lake	55.0	1.603	.514
Ellsworth	--	--	--
Mancelona	142.4	.763	.157
BARRY			
Hastings	292.6	1.465	.465
Middleville	110.1	--	--
Nashville	45.0	.482	.001
BENZIE			
Beulah	18.5	--	--
Frankfort	86.1	--	--
BERRIEN			
Berrien Springs	166.6	.753	.288
Buchanan	420.9	2.473	.557
Coloma	161.4	.786	.275
Niles	881.4	3.830	1.300
Niles Twp.	52.4	.810	.052
Watervliet	76.2	.438	.095
BRANCH			
Bronson	362.2	--	--
Coldwater	1,122.7	5.170	1.692
Quincy	81.9	--	--
Reg. Center Dev. Disab.	53.3	.227	.083
Union City	52.7	--	--
CALHOUN			
Albion	1,007.6	3.893	1.839
Athens	41.0	--	--
Battle Creek	3,590.6	14.810	5.580
Battle Creek Twp.	618.5	3.105	1.084
Homer	55.6	.244	.075
Marshall	501.1	3.378	.566
CASS			
Cassopolis	85.0	.583	.124
Dowagiac	325.1	1.898	.005
CHARLEVOIX			
Boyne City	174.4	1.018	.185
East Jordan	201.8	1.070	.264
CHEBOYGAN			
Mackinaw City	88.5	.491	.105
CLARE			
Clare	236.7	1.253	.417
Farwell	47.6	.260	.050
Harrison	75.0	.248	.158

COUNTY AND WATER USER	1982 TOTAL	MAX DAY	MIN DAY
CLINTON			
Fowler	25.6	.259	.033
Maple Rapids	21.4	--	.047
Ovid	75.0	.380	.064
St. Johns	413.5	1.769	.631
Westphalia	20.1	.214	--
CRAWFORD			
Grayling	201.3	.963	.291
DICKINSON			
Breitung Twp.	64.9	--	--
EATON			
Bellevue	50.5	.180	.085
Charlotte	378.0	2.235	.055
Delta Twp.	898.6	8.541	.629
Eaton Rapids	314.2	1.318	.561
Grand Ledge	235.5	1.163	.351
Sunfield	32.4	--	--
EMMET			
Harbor Springs	193.1	1.668	.313
Petosky	542.5	2.342	1.031
GENESEE			
Beecher Metro. Dist.	490.5	2.103	.955
Burton	267.2	1.409	.490
Davison	298.1	2.066	.000
Fenton	288.5	1.276	.475
Grand Blanc	381.5	2.082	.602
Grand Blanc Twp.	137.6	--	--
Linden	60.0	.290	.100
Montrose	8.8	.321	.109
Otisville	17.3	--	--
GLADWIN			
Beaverton	44.2	--	--
GOGEBIC			
Ironwood	482.0	1.752	.881
Marenisco Twp.	63.1	.352	.113
Wakefield	101.6	.407	.184
GRAND TRAVERSE			
Kingsley	29.4	--	--
GRATIOT			
Alma	43.0	--	--
Breckenridge	38.9	.210	.051
Ithaca	117.6	--	--
St. Louis	139.0	.860	.237
HILLSDALE			
Hillsdale	427.2	1.862	.791
Jonesville	154.7	1.083	.185
Litchfield	53.3	.379	.096
Waldron	34.2	.155	.053
HOUGHTON			
a)Adams Twp. - S. Range Water Auth.	313.1	1.279	.825
b)Adams Twp. - S. Range Water Auth.	96.7	.410	.207
Chassel Twp.	48.7	.223	.096
Houghton	424.0	1.812	.733
c)N. Michigan Water Co.	353.0	1.498	.389

Table 2.--Reported ground-water pumpage--Continued
(in millions of gallons)

COUNTY AND WATER USER	1982 TOTAL	MAX DAY	MIN DAY
HURON			
Elkton	26.9	--	--
Pigeon	53.2	--	--
Sebewaing	130.6	--	--
INGHAM			
E. Lansing-Meridian Twp.	1,804.3	8.519	3.012
Lansing	8,182.2	33.340	14.783
Lansing Twp.	515.0	--	--
Leslie	94.1	--	--
Mason	227.7	--	--
Michigan State Univ.	1,583.2	5.496	1.894
Stockbridge	47.2	.254	.048
Webberville	49.3	.292	--
Williamston	105.5	.527	.162
IONIA			
Belding	509.4	--	--
Ionia	322.5	1.910	.473
Ionia State Hosp.	46.7	.286	.079
Mich. Reformatory, Ionia	194.9	--	--
Mich. Training Unit, Ionia	58.8	.279	.131
d)Muir	49.4	--	--
Pewamo	18.6	--	--
Portland	141.5	--	--
Saranac	109.8	.571	.119
IOSCO			
Oscoda Twp.	211.7	--	--
Wurtsmith AFB	214.3	1.302	.074
IRON			
Alpha	e)10.4	--	--
Caspian	83.2	.329	.114
Crystal Falls	159.2	.672	.313
Crystal Falls Twp.	109.5	.920	--
Iron River	127.7	.576	.232
Iron River Twp.	165.1	--	--
Stambaugh	70.4	.294	.121
Stambaugh Twp.	38.3	--	--
ISABELLA			
f)Mt. Pleasant	814.0	2.800	1.500
Shepherd	46.3	--	.017
JACKSON			
Concord	41.5	.213	.063
Grass Lake	227.0	1.337	.370
Jackson	3,313.7	14.360	4.390
Springport	32.5	--	--
State Prison, Jackson	488.8	--	--
KALAMAZOO			
Augusta	24.7	.116	.046
Galesburg	80.4	.633	.088
James River Corp.	625.0	3.829	.190
Kalamazoo	5,771.6	32.843	4.185
Parchment	89.2	.718	.063
Portage	1,000.1	7.049	.731
Simpson Paper Co.	251.7	1.992	.511
Upjohn Co.	6,039.0	23.186	8.898
Vicksburg	116.5	.608	.162
KALKASKA			
Kalkaska	141.6	.842	.213
KENT			
Alloytek, Inc.	78.4	.664	.500
Cedar Springs	120.6	.852	.110
Kent County Airport	e)12.0	--	--
Lowell	237.6	1.087	.282
Plainfield Twp.	589.9	3.125	1.022
Sparta	145.3	.728	.270

COUNTY AND WATER USER	1982 TOTAL	MAX DAY	MIN DAY
LAKE			
Baldwin	64.8	.415	.077
LAPEER			
Columbiaville	36.5	.161	.062
Dryden	13.5	--	--
North Branch	27.5	.150	--
LEELANAU			
Northport	21.4	.215	.003
LENAWEE			
Britton	18.6	.077	.036
Clinton	88.7	--	--
Hudson	96.3	.530	.110
Morenci	100.1	.479	.111
Onsted	41.7	--	--
Tecumseh	366.1	1.826	.377
Fisher Body, Tecumseh	7.4	.151	.000
LIVINGSTON			
Brighton	284.5	1.300	.430
Fowlerville	107.4	.486	.186
Howell	414.5	1.775	.757
Maxey Boys School	43.1	.536	.062
LUCE			
Newberry	108.0	--	--
Newberry Health Center	29.6	--	--
MACOMB			
Armada	36.5	.203	.045
Richmond	138.5	--	--
Romeo	223.6	--	--
MANISTEE			
Filer Twp.	53.0	.752	.000
Manistee	393.3	--	--
MARQUETTE			
Ishpeming Twp.	132.3	--	--
K. I. Sawyer AFB	471.1	2.344	.916
Powell Twp.	e)7.9	--	--
Richmond Twp.	e)41.1	--	--
MENOMINEE			
Stephenson	37.4	.174	.075
MIDLAND			
Coleman	48.2	.254	.082
MISSAUKEE			
Lake City	53.6	.437	--
MONROE			
Milan	264.0	--	--
Petersburg	35.9	.140	.062
MONTCALM			
Carson City	59.8	.290	.100
Edmore	56.3	.436	.057
Greenville	737.0	4.002	.948
Howard City	36.4	.394	.055
Sheridan	28.0	--	--
Stanton	9116	--	--
MUSKEGON			
Montague	81.6	--	--
Ravenna	28.2	--	--

Table 2.--Reported ground-water pumpage--Continued

(in millions of gallons)

COUNTY AND WATER USER	1982 TOTAL	MAX DAY	MIN DAY
NEWAYGO			
Fremont	360.8	2.345	.066
Hesperia	18.7	--	--
Newaygo	45.6	.398	.049
White Cloud	107.3	.520	.140
OAKLAND			
Holly	154.1	.645	.295
Independence Twp.	129.3	--	--
Milford	215.2	1.100	.372
Orion Twp.	239.6	1.597	.390
Oxford	147.6	.954	.081
Rochester	683.2	3.479	1.009
Southfield	e)4.1	--	--
Sylvan Lake	65.8	--	--
Walled Lake	256.0	--	--
Waterford Twp.	1,875.5	--	--
Wolverine Lake	e)41.3	--	--
South Lyon	677.7	2.240	--
OCEANA			
Hart	181.3	--	--
Pentwater	56.9	1.073	.078
Shelby	16.4	--	--
OGEMAW			
West Branch	117.7	.548	.146
ONTONGAON			
Bergland Twp.	10.6	--	--
Rockland Twp.	11.8	.052	.018
OSCEOLA			
Evart	665.4	3.257	.400
Marion	43.3	.178	.097
Reed City	137.0	--	--
OTSEGO			
Gaylord	197.4	--	--
Alpine Center, Gaylord	9.1	.038	.004
OTTAWA			
Spring Lake	134.4	--	--
PRESQUE ISLE			
Onaway	58.7	.260	--
Rogers City	154.6	1.237	.205
SAGINAW			
Chesaning	100.4	.546	.177
Tittabawassee Twp.	86.8	.310	.182
ST. CLAIR			
Capac	53.3	.483	.073
ST. JOSEPH			
Constantine	114.8	.795	.137
Sturgis	e)893.0	4.308	.492
SANILAC			
Croswell	181.3	.923	.129
Deckerville	52.3	.238	.063
Marlette	90.8	.512	.157
Peck	24.2	.127	.046
Port Sanilac	39.1	.208	.060
Sandusky	207.3	.946	.190
SHIAWASSEE			
Bancroft	17.7	--	--
Byron	21.8	--	--
Durand	136.7	.566	.245
Owosso	e)817.2	3.117	1.300
Perry	58.6	--	--
TUSCOLA			
Akron	3.2	--	--
Caro	216.6	--	--
Cass City	89.5	.533	.167
Kingston	13.2	--	--
Mayville	29.7	--	--
State Hosp., Caro	33.6	.180	.040
Vassar	217.8	3.577	.233
VAN BUREN			
Bangor	65.3	.352	.074
Decatur	109.5	--	--
Gobles	22.0	.121	.034
Hartford	111.4	.563	.107
Lawrence	39.9	--	--
Lawton	303.0	1.770	.130
Paw Paw	191.0	1.182	.051
WASHTENAW			
Ann Arbor	g)719.7	4.060	.481
Chelsea	180.8	1.168	.323
Dexter	78.9	--	--
Saline	495.3	2.039	.657
Webster Twp.	45.8	.519	.009
Ypsilanti	1,196.4	6.029	1.717
Ypsilanti Twp.	131.1	3.950	.000
WEXFORD			
Cadillac	633.8	3.014	1.162
Manton	48.1	.225	.035

NOTES

a) Amount pumped to supply Houghton, Hancock, Portage Township, Cooper Range Company, and Atlantic Mine.
b) Amount pumped to supply Painesdale, Trimountain, Baltic, and South Range.
c) Amount pumped to supply Calumet, Calumet Township, Copper City, Lake Linden, Laurin, Osceola Township, Torch Lake Township, Ahmeek, and Allouez Township.
d) Supplies water to Lyons.
e) Wholly or partly estimated.
f) Use Ranney collecter system at Chippewa River site.
g) Also pumped 4,696 million gallons from Huron River.

Table 3.--Water-quality data

LOCAL IDENTIFIER: See section in text entitled "Well-numbering system"; also includes abbreviated spelling of county name.
GEOLOGIC UNIT: 112GLCL Glacial deposits; 112OTSH Outwash; 112SAND Sand; 337MRSL Marshall Formation; 341TRVR Traverse Group; 355ENGD Engadine Dolomite; 365BKRV Black River Formation; 400FRED Freda Sandstone
UNITS: Units are reported in NTU = Nephelometric Turbidity Units, MG/L = Milligrams per liter; UG/L = Micrograms per liter; PCI/L = Picocuries per liter.

LOCAL IDENTIFIER		DATE OF SAMPLE	GEOLOGIC UNIT	DEPTH OF WELL, TOTAL (FEET)	TEMPERATURE (DEG C)	TURBIDITY (NTU)	COLOR (PLATINUM-COBALT UNITS)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	NITROGEN, TOTAL (MG/L AS N)	NITROGEN, ORGANIC TOTAL (MG/L AS N)
32N 06E 23DDDA01	ALPENA	82-09-16	112SAND	88	10.0	3.5	7	412	--	--	1.1
26N 14W 13AABB01	RENZIE	82-09-15	112SAND	214	9.5	<1.0	7	551	7.5	--	.06
26N 14W 13ABAA01	RENZIE	82-09-15	112SAND	50	9.5	<1.0	8	392	--	--	1.0
01S 07W 32BDCC01	CALHUN	82-09-21	337MRSL	95	11.5	<1.0	<1	712	7.5	--	1.1
46N 04W 24DADA01	CHIPWA	82-09-15	112OTSH	54	8.0	1.1	6	46	6.0	--	--
35N 04W 18BCAC01	EMMET	82-09-16	112SAND	330	9.0	<1.0	7	326	--	.90	.46
35N 04W 19BCAC02	EMMET	82-09-16	341TRVR	471	9.0	<1.0	8	353	--	--	--
26N 09W 14ABAA01	GD TRV	82-09-15	112SAND	80	8.5	<1.0	7	241	7.5	1.9	1.2
04S 11W 03CDDA01	KALMZO	82-09-21	112OTSH	190	11.0	38	<1	461	7.6	--	1.1
07N 11E 03DDBC01	LAPEER	82-09-22	112GLCL	64	10.0	13	1	543	7.5	--	1.2
43N 09W 13DDDA01	MACKNC	82-09-16	355ENGD	54	7.5	5.8	63	304	7.7	--	--
33N 27W 35BBCB01	MENOME	82-09-15	365BKRV	147	8.5	<1.0	3	1025	6.9	--	.63
51N 41W 08BDBC01	ONTNGN	82-09-23	400FRED	100	7.5	220	4	553	8.1	--	--
07N 14E 27AABC01	ST CLR	82-09-22	112GLCL	55	10.0	18	1	715	7.2	--	.54
13N 13E 12ADAA01	SANLAC	82-09-22	337MRSL	130	9.5	1.0	2	351	8.0	--	.77

LOCAL IDENTIFIER		NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, NITRITE TOTAL (MG/L AS N)	NITROGEN, NITRATE TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	PHOSPHORUS, TOTAL (MG/L AS P)	CARBON, ORGANIC DISSOLVED (MG/L AS C)	CARBON, ORGANIC SUSPENDED TOTAL (MG/L AS C)	CYANIDE TOTAL (MG/L AS CN)	HARDNESS (MG/L AS CACO3)
32N 06E 23DDDA01	ALPENA	.050	<.010	--	1.10	<.10	.190	2.1	.3	<.01	227
26N 14W 13AABB01	RENZIE	.340	.030	--	.40	<.10	.060	1.6	.2	<.01	89
26N 14W 13ABAA01	RENZIE	.100	<.010	--	1.10	<.10	.010	1.2	.2	<.01	208
01S 07W 32BDCC01	CALHUN	.030	<.010	--	1.10	<.10	<.010	.7	.1	<.01	363
46N 04W 24DADA01	CHIPWA	.030	<.010	--	<.10	<.10	<.010	1.4	.1	<.01	11
35N 04W 18BCAC01	EMMET	.040	<.010	--	.50	.40	<.010	.6	.2	<.01	172
35N 04W 19BCAC02	EMMET	.020	<.010	--	<.10	<.10	.010	.8	.2	<.01	184
26N 09W 14ABAA01	GD TRV	.040	<.010	--	1.20	.70	<.010	1.5	.2	<.01	131
04S 11W 03CDDA01	KALMZO	.100	.010	--	1.20	<.10	.070	1.0	.1	--	148
07N 11E 03DDBC01	LAPEER	.110	<.010	--	1.30	<.10	<.010	1.4	--	<.01	275
43N 09W 13DDDA01	MACKNC	.070	<.010	--	<.10	<.10	.040	6.3	.2	<.01	158
33N 27W 35BBCB01	MENOME	.170	.020	--	.80	<.10	.020	1.9	.1	<.01	448
51N 41W 08BDBC01	ONTNGN	.490	.210	.29	<.10	.50	.190	1.3	.3	<.01	91
07N 14E 27AABC01	ST CLR	.360	<.010	--	.90	<.10	.030	1.6	--	<.01	206
13N 13E 12ADAA01	SANLAC	.030	<.010	--	.80	<.10	.010	.6	.1	<.01	181

LOCAL IDENTIFIER		CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	SODIUM ADSORPTION RATIO	PERCENT SODIUM	POTASSIUM, DISSOLVED (MG/L AS K)	CHLORIDE, DISSOLVED (MG/L AS CL)	SULFATE DISSOLVED (MG/L AS SO4)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)
32N 06E 23DDDA01	ALPENA	68	14	2.0	.1	2	.4	1.3	13	.2	12
26N 14W 13AABB01	RENZIE	19	10	84	4.0	67	1.1	67	14	1.2	12
26N 14W 13ABAA01	RENZIE	57	16	3.7	.1	4	.7	4.1	16	.5	15
01S 07W 32BDCC01	CALHUN	99	28	19	.4	10	.8	48	67	.1	12
46N 04W 24DADA01	CHIPWA	3.5	.6	.9	.1	13	1.5	.4	8.0	<.1	7.3
35N 04W 18BCAC01	EMMET	44	15	1.8	.1	2	.5	.7	5.0	.5	10
35N 04W 19BCAC02	EMMET	44	18	3.2	.1	4	.8	1.5	12	1.5	10
26N 09W 14ABAA01	GD TRV	39	8.1	.9	.0	1	.6	.5	9.0	.1	7.7
04S 11W 03CDDA01	KALMZO	23	22	4.5	.2	6	.9	3.0	23	.2	15
07N 11E 03DDBC01	LAPEER	69	25	7.7	.2	6	1.3	2.8	7.0	.9	19
43N 09W 13DDDA01	MACKNC	40	14	1.6	.1	2	.8	1.3	11	.1	12
33N 27W 35BBCB01	MENOME	120	36	21	.4	9	3.9	77	84	.3	11
51N 41W 08BDBC01	ONTNGN	28	5.2	77	3.6	63	5.5	50	14	.3	9.6
07N 14E 27AABC01	ST CLR	15	41	15	.5	14	1.6	2.5	14	.6	23
13N 13E 12ADAA01	SANLAC	46	16	2.0	.1	2	.4	2.2	26	.1	8.3

Table 3.--Water-quality data--Continued

LOCAL IDENTIFIER		ARSENIC TOTAL (UG/L AS AS)	BARIUM, TOTAL RECOVERABLE (UG/L AS BA)	BERYLLIUM, TOTAL RECOVERABLE (UG/L AS BE)	BISMUTH DISSOLVED (UG/L AS BI)	BORON, TOTAL RECOVERABLE (UG/L AS B)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR)	COBALT, TOTAL RECOVERABLE (UG/L AS CO)	COPPER, TOTAL RECOVERABLE (UG/L AS CU)	IRON, TOTAL RECOVERABLE (UG/L AS FE)
32N 06E 23DDDA01	ALPENA	2	<100	<10	<1000	<10	1	10	3	8	880
26N 14W 13AABB01	BENZIE	9	100	<10	<1000	130	1	10	3	2	100
26N 14W 13ABAA01	BENZIE	2	<100	<10	<1000	<10	1	10	4	9	360
01S 07W 32BDCC01	CALHUN	2	200	<10	<1000	30	1	10	<1	3	230
46N 04W 24DADA01	CHIPWA	1	<100	<10	<1000	<10	1	<10	2	720	1900
35N 04W 18BCAC01	EMMET	1	<100	<10	<1000	<10	1	10	5	4	30
35N 04W 18BCAC02	EMMET	1	100	<10	<1000	<10	1	10	3	2	180
26N 09W 14ABAA01	GD TRV	2	<100	<10	<1000	<10	1	10	4	3	40
04S 11W 03CDDA01	KALMZO	3	100	<10	<1000	10	<1	10	3	2	700
07N 11E 03DDBC01	LAPEER	61	200	<10	<1000	20	<1	10	1	6	860
43N 09W 13DDDA01	MACKNC	2	100	<10	<1000	20	2	<10	4	39	3100
33N 27W 35BBCB01	MENOME	2	100	<10	<1000	340	<1	10	3	4	180
51N 41W 08BDBC01	ONTNGN	3	200	<10	<1000	2400	1	20	7	85	7100
07N 14E 27AABC01	ST CLR	21	300	<10	<1000	90	<1	10	<1	17	2600
13N 13E 12ADAA01	SANLAC	1	<100	<10	<1000	10	<1	10	<1	2	320

LOCAL IDENTIFIER		IRON, DISSOLVED (UG/L AS FE)	LEAD, TOTAL RECOVERABLE (UG/L AS PB)	MANGANESE, SUSPENDED RECOV. (UG/L AS MN)	MANGANESE, TOTAL RECOVERABLE (UG/L AS MN)	MANGANESE, DISSOLVED (UG/L AS MN)	MOLYBDENUM, TOTAL RECOVERABLE (UG/L AS MO)	NICKEL, TOTAL RECOVERABLE (UG/L AS NI)	SILVER, TOTAL RECOVERABLE (UG/L AS AG)	STRONTIUM, TOTAL RECOVERABLE (UG/L AS SR)	VANADIUM, DISSOLVED (UG/L AS V)
32N 06E 23DDDA01	ALPENA	600	5	10	120	110	1	3	<1	70	<10
26N 14W 13AABB01	BENZIE	92	5	5	10	5	10	1	<1	570	10
26N 14W 13ABAA01	BENZIE	200	7	10	20	10	1	3	<1	200	<10
01S 07W 32BDCC01	CALHUN	120	3	0	70	71	<1	3	<1	70	10
46N 04W 24DADA01	CHIPWA	42	41	6	10	4	12	2	<1	40	<10
35N 04W 18BCAC01	EMMET	3	4	--	<10	1	1	1	<1	130	10
35N 04W 18BCAC02	EMMET	120	5	--	<10	4	<1	2	<1	370	<10
26N 09W 14ABAA01	GD TRV	3	4	--	<10	1	1	3	<1	50	<10
04S 11W 03CDDA01	KALMZO	530	1	0	180	180	4	1	<1	100	30
07N 11E 03DDBC01	LAPEER	660	3	6	20	14	5	1	<1	280	10
43N 09W 13DDDA01	MACKNC	2500	7	30	140	110	1	3	<1	160	10
33N 27W 35BBCB01	MENOME	43	2	3	20	17	<1	2	<1	870	10
51N 41W 08BDBC01	ONTNGN	80	15	190	200	9	<1	16	<1	510	30
07N 14E 27AABC01	ST CLR	2400	4	0	30	37	6	3	<1	800	<10
13N 13E 12ADAA01	SANLAC	280	3	0	30	38	<1	1	<1	90	10

LOCAL IDENTIFIER		ZINC, TOTAL RECOVERABLE (UG/L AS ZN)	TIN, DISSOLVED (UG/L AS SN) (A.A.S. DIRECT)	ALUMINUM, TOTAL RECOVERABLE (UG/L AS AL)	GALLIUM DISSOLVED (UG/L AS GA)	GERMANIUM, DISSOLVED (UG/L AS GE)	LITHIUM TOTAL RECOVERABLE (UG/L AS LI)	SELENIUM, TOTAL (UG/L AS SE)	TITANIUM, DISSOLVED (UG/L AS TI)	ZIRCONIUM, DISSOLVED (UG/L AS ZR)	TRITIUM TOTAL (PCI/L)
32N 06E 23DDDA01	ALPENA	120	<50	180	50	100	<10	<1	<5	<5	<200
26N 14W 13AABB01	BENZIE	60	<50	60	30	100	10	<1	<5	<5	<200
26N 14W 13ABAA01	BENZIE	240	<50	50	30	70	10	<1	<5	<5	<200
01S 07W 32BDCC01	CALHUN	30	<50	<10	30	100	<10	<1	<5	<5	<200
46N 04W 24DADA01	CHIPWA	270	<50	20	<30	<30	<10	<1	<5	<5	340
35N 04W 18BCAC01	EMMET	50	<50	40	50	100	<10	<1	<5	<5	<200
35N 04W 18BCAC02	EMMET	30	<50	40	<30	100	<10	<1	<5	<5	<200
26N 09W 14ABAA01	GD TRV	80	<50	40	50	50	<10	<1	<5	<5	<200
04S 11W 03CDDA01	KALMZO	20	<50	20	30	100	<10	<1	<5	<5	<200
07N 11E 03DDBC01	LAPEER	110	<50	30	<30	100	10	<1	<5	<5	<200
43N 09W 13DDDA01	MACKNC	500	<50	40	<30	70	<10	<1	<5	<5	260
33N 27W 35BBCB01	MENOME	300	<50	40	30	100	10	<1	<5	<5	<200
51N 41W 08BDBC01	ONTNGN	50	<50	6400	70	50	100	<1	7	<50	<200
07N 14E 27AABC01	ST CLR	410	<50	<10	<30	100	10	<1	<5	<5	<200
13N 13E 12ADAA01	SANLAC	20	<50	30	50	100	10	<1	<5	<5	<200

Table 3.--Water-quality data--Continued

LOCAL IDENTIFIER		PHENOLS (UG/L)	PERTHANE TOTAL (UG/L)	NAPHTHALENES, POLYCHLOR. TOTAL (UG/L)	ALDRIN, TOTAL (UG/L)	LINDANE TOTAL (UG/L)	CHLORDANE, TOTAL (UG/L)	DDD, TOTAL (UG/L)	DDE, TOTAL (UG/L)	DDT, TOTAL (UG/L)	DIELDRIN TOTAL (UG/L)
32N 06E 23DDDA01	ALPENA	6	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
26N 14W 13AABB01	BENZIE	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
26N 14W 13ABAA01	BENZIE	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
01S 07W 32BDCC01	CALHUN	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
46N 04W 24DADA01	CHIPWA	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
35N 04W 18BCAC01	EMMET	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
35N 04W 18BCAC02	EMMET	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
26N 09W 14ABAA01	GD TRV	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
04S 11W 03CDDA01	KALMZO	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
07N 11E 03DDBC01	LAPEER	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
43N 09W 13DDDA01	MACKNC	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
33N 27W 35BBCB01	MENOME	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
51N 41W 08BOBC01	ONTNGN	24	--	--	--	--	--	--	--	--	--
07N 14E 27AABC01	ST CLR	<1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01
13N 13E 12ADAA01	SANLAC	1	<.10	<.10	<.01	<.01	<.10	<.01	<.01	<.01	<.01

LOCAL IDENTIFIER		ENDOSULFAN, TOTAL (UG/L)	ENDRIN, TOTAL (UG/L)	ETHION, TOTAL (UG/L)	TOXAPHENE, TOTAL (UG/L)	HEPTACHLOR, TOTAL (UG/L)	HEPTACHLOR EPOXIDE TOTAL (UG/L)	PCB, TOTAL (UG/L)	MALATHION, TOTAL (UG/L)	PARATHION, TOTAL (UG/L)	DIAZINON, TOTAL (UG/L)
32N 06E 23DDDA01	ALPENA	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
26N 14W 13AABB01	BENZIE	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
26N 14W 13ABAA01	BENZIE	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
01S 07W 32BDCC01	CALHUN	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
46N 04W 24DADA01	CHIPWA	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
35N 04W 18BCAC01	EMMET	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
35N 04W 18BCAC02	EMMET	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
26N 09W 14ABAA01	GD TRV	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
04S 11W 03CDDA01	KALMZO	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
07N 11E 03DDBC01	LAPEER	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
43N 09W 13DDDA01	MACKNC	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
33N 27W 35BBCB01	MENOME	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
51N 41W 08BOBC01	ONTNGN	--	--	--	--	--	--	--	--	--	--
07N 14E 27AABC01	ST CLR	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01
13N 13E 12ADAA01	SANLAC	<.01	<.01	<.01	<1	<.01	<.01	<.10	<.01	<.01	<.01

LOCAL IDENTIFIER		METHYL PARATHION, TOTAL (UG/L)	2,4-D, TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	MIREX, TOTAL (UG/L)	SILVEX, TOTAL (UG/L)	TOTAL TRITHION (UG/L)	METHYL TRITHION, TOTAL (UG/L)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P)
32N 06E 23DDDA01	ALPENA	<.01	<.01	<.01	<.01	<.01	<.01	<.01	228	243	.160
26N 14W 13AABB01	BENZIE	<.01	<.01	<.01	<.01	<.01	<.01	<.01	310	309	.040
26N 14W 13ABAA01	BENZIE	<.01	<.01	<.01	<.01	<.01	<.01	<.01	230	235	<.010
01S 07W 32BDCC01	CALHUN	<.01	<.01	<.01	<.01	<.01	<.01	<.01	302	416	<.010
46N 04W 24DADA01	CHIPWA	<.01	<.01	<.01	<.01	<.01	<.01	<.01	30	28	.010
35N 04W 18BCAC01	EMMET	<.01	<.01	<.01	<.01	<.01	<.01	<.01	158	185	<.010
35N 04W 18BCAC02	EMMET	<.01	<.01	<.01	<.01	<.01	<.01	<.01	190	201	<.010
26N 09W 14ABAA01	GD TRV	<.01	<.01	<.01	<.01	<.01	<.01	<.01	125	143	<.010
04S 11W 03CDDA01	KALMZO	<.01	<.01	<.01	<.01	<.01	<.01	<.01	206	171	.020
07N 11E 03DDBC01	LAPEER	<.01	<.01	<.01	<.01	<.01	<.01	<.01	241	278	<.010
43N 09W 13DDDA01	MACKNC	<.01	<.01	<.01	<.01	<.01	<.01	<.01	188	176	.040
33N 27W 35BBCB01	MENOME	<.01	<.01	<.01	<.01	<.01	<.01	<.01	430	565	<.010
51N 41W 08BOBC01	ONTNGN	--	<.01	<.01	--	<.01	--	--	284	303	.460
07N 14E 27AABC01	ST CLR	<.01	<.01	<.01	<.01	<.01	<.01	<.01	260	246	<.010
13N 13E 12ADAA01	SANLAC	<.01	<.01	<.01	<.01	<.01	<.01	<.01	188	189	<.010

Table 3.--Water-quality data--Continued

LOCAL IDENTIFIER		PHOSPHORUS TOTAL (MG/L AS P04)	NITROGEN, TOTAL (MG/L AS N03)	MERCURY TOTAL RECOVERABLE (UG/L AS HG)	URANIUM DISSOLVED, EXTRACTION (UG/L)	2, 4-DP TOTAL (UG/L)	ALKALINITY LAB (MG/L AS CACO3)	HARDNESS NONCARBONATE (MG/L AS CACO3)
32N 06E 23ODDA01	ALPENA	.58	--	<.1	.11	<.01	219	9.0
26N 14W 13AABB01	BENZIE	.18	--	<.1	.07	<.01	167	.00
26N 14W 13ABAA01	BENZIE	.03	--	<.1	--	<.01	203	5.0
01S 07W 32BDCC01	CALHUN	--	--	<.1	--	<.01	236	130
46N 04W 24DADA01	CHIPWA	--	--	<.1	<.01	<.01	9.0	2.0
35N 04W 18BCAC01	EMMET	--	4.0	<.1	.26	<.01	179	.00
35N 04W 18BCAC02	EMMET	.03	--	<.1	.14	<.01	183	1.0
26N 09W 14ABAA01	GD TRV	--	8.4	<.1	.18	<.01	128	3.0
04S 11W 03CDDA01	KALMZO	.21	--	<.1	.49	<.01	131	17
07N 11E 03DDHC01	LAPEER	--	--	<.1	--	<.01	240	36
43N 09W 13DDDA01	MACKNC	.12	--	<.1	.02	<.01	154	4.0
33N 27W 35BBCB01	MENOME	.06	--	<.1	.28	<.01	352	96
51N 41W 08BDBC01	ONTNGN	.58	--	<.1	--	<.01	165	.00
07N 14E 27AABC01	ST CLR	.09	--	<.1	--	<.01	218	.00
13N 13E 12ADAA01	SANLAC	.03	--	<.1	.09	<.01	146	35

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Year	WSP Number	Year	WSP Number	Year	WSP Number
1935	777	1944	1016	1953	1265
1936	817	1945	1023	1954	1321
1937	840	1946	1071	1955	1404
1938	845	1947	1096	1956-57	1537
1939	886	1948	1126	1958-62	1782
1940	906	1949	1156	1963-67	1977
1941	936	1950	1165	1968-72	2140
1942	944	1951	1191		
1943	986	1952	1221		

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1975	MI-75-1
1976	MI-76-1
1977	MI-77-1
1978	MI-78-1
1979	MI-79-1
1980	MI-80-1
1981	MI-81-1
1982	MI-82-1