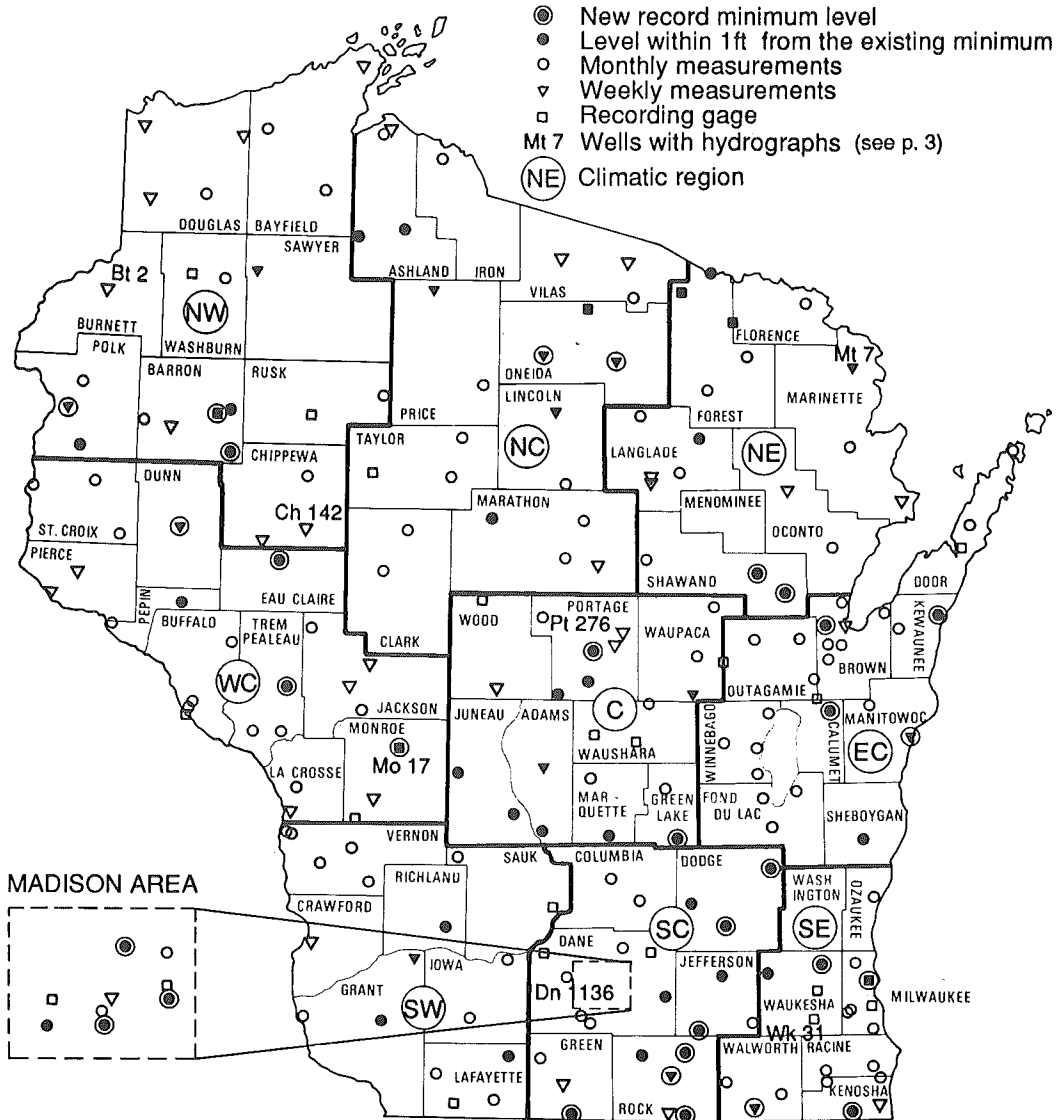
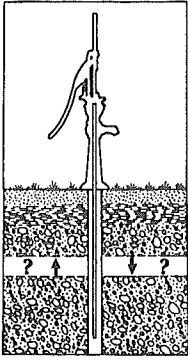


GROUNDWATER LEVELS IN WISCONSIN, SUMMARY 1988-89

Alexander Zaporozec

(Compilation of data: Pamela Naber and Cheryl Olson)

1990



EFFECTS OF THE 1988-89 DROUGHT ON GROUND WATER LEVELS

Published by and available from
WLEX University of Wisconsin-Extension
 Geological and Natural History Survey
 3817 Mineral Point Road
 Madison, Wisconsin 53705
 (608) 262-1705

In cooperation with
 U.S. Department of Interior
 Geological Survey
 Water Resources Division
 Madison District Office
 6417 Normandy Lane
 Madison, Wisconsin 53705

Groundwater levels in Wisconsin were significantly affected by drought in 1988-89. (We define drought as a year in which precipitation is 85% of normal or less.) Beginnings of the drought and its impact on groundwater levels can be traced back to the end of 1986. The winter of 1986-87 was unusually mild and dry and had the lowest average snow depths in 25 years. The lack of snow cover (and consequently, snowmelt) and drought conditions in the first half of 1987 (precipitation for November 1986 through June 1987 was only 66% of normal for the state) resulted in the decline of groundwater levels. The three months with above-average precipitation (August, November, and December 1987) provided some relief, but recharge in these months was not sufficient to offset the effects of the lack of spring recharge.

Near-normal conditions prevailed during the winter of 1987-88. Early spring-like temperatures in March 1988 melted snow cover and thawed frozen ground, and the snowmelt somewhat recharged groundwater and caused groundwater levels to rise temporarily. However, the spring and summer of 1988 will be remembered as one of the driest on record. After the middle of April, Wisconsin received only sporadic rains. Precipitation for April through July averaged 51 percent of normal for the state, and in May and June it did not even reach 40 percent of normal. In August and September rainfall was near or above normal amounts, but October was again dry. Even though November rainfall amounts were well above normal, the state annual average for 1988 was only 82 percent of normal.

As the 1988 drought continued, the usual groundwater recharge that occurs in spring was less than expected in most of the state because of the lack of significant spring rainfall. Water levels in observation wells declined from April until October 1988, when they stabilized as a result of the August and September rains. The effects of the drought on groundwater were most severe in the east-central and three southern regions. November rains resulted in a small rise in water levels in most of the state, except in the southwest region where no fall recharge was recorded. In comparison with the long-term average, water levels in Wisconsin observation wells fell below normal in most of the state during 1988. Only in parts of the west-central, central, and southwest regions did water levels remain above normal.

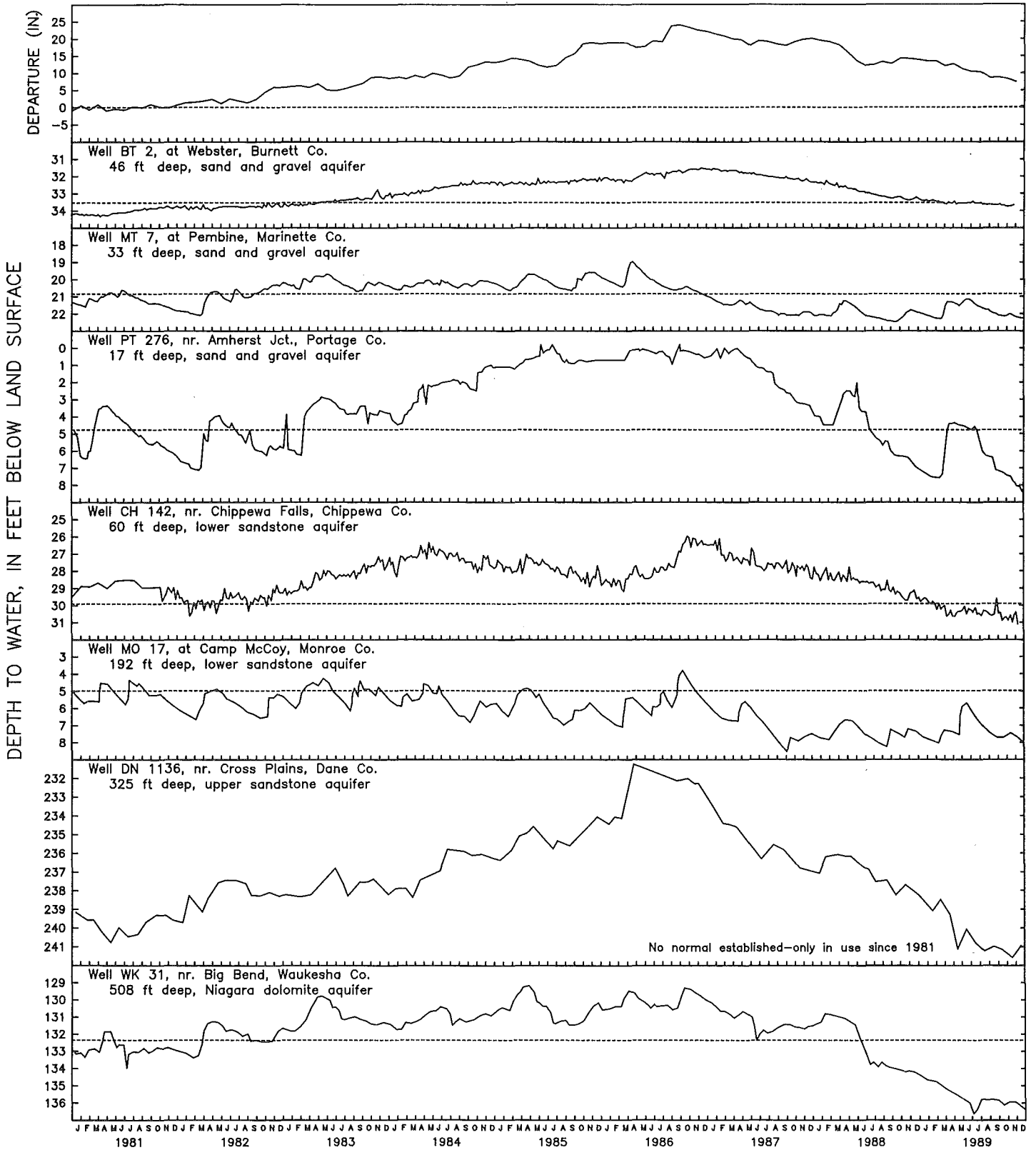
The year 1989 did not fare any better than 1988. The winter of 1988-89 was again moderate. Snow coverage was low and frost depths were greater than normal. Average rainfall in March resulted in a small rise of water levels. Precipitation in April averaged only 50 percent of normal, and significant rains did not come until late May and early June. Summer and fall were very dry, except in August and October. The more frequent rains that occurred when most needed made 1989 a much better year for crops than the previous year; thus, the continuing drought conditions went relatively unnoticed. A dry autumn further contributed to drought conditions. The annual average precipitation for 1989 was again below normal, even lower than in 1988: 78 percent of normal for the state, making it two drought years in a row.

The drought and its effects on water levels have continued through 1989. In the spring, water levels in most observation wells rose later than usual and only slightly. Groundwater recharge, which usually occurs in April, did not occur until June, except in the south-central region, where slightly higher water levels were recorded in April. In the southwest region spring rainfall was well below normal and groundwater recharge did not occur at all. During the summer, water levels in Wisconsin observation wells started to decline again. No significant recharge to groundwater was recorded during the fall, and water levels continued to decline in early 1990. The number of observation wells that were at or near record low levels reached 65 in 1989 (see map on page 1), which is more than 40 percent of observation wells with a record of 15 years or longer. At the end of 1989, the effects of the continued drought on groundwater were most noticeable in the sandstone and dolomite aquifers in southern and eastern Wisconsin. In the northern and central parts of the state, which received beneficial rains in May and October, the water levels in observation wells did not fluctuate much and remained at about the same level throughout the year. With respect to long-term averages, water levels in Wisconsin observation wells remained below normal in 1989, except for 25 wells in isolated pockets of primarily northwest, west-central, and east-central regions.

Hydrographs on page 3 show fluctuations of water levels in selected key wells since 1981 (for locations, see map on page 1). Seasonal fluctuations for each year show that water levels generally declined during the summer, fall, and winter, and rose during the spring. The long-range fluctuations reflect the precipitation patterns. In general, water levels rose from 1981 to 1986 because of a 10-year period of above-normal precipitation (1977-86). Since 1986 the water levels have been declining. Similar trends can be observed on other observation wells in the state.

Hydrographs for key wells are available from the Wisconsin Geological and Natural History Survey (WGNHS) and U.S. Geological Survey (USGS). These two organizations have jointly operated a network of observation wells around the state to monitor water-level fluctuations since 1946. In 1989 measurements were made in 210 wells. Locations and records for these observation wells (see map on page 1) are available from WGNHS and USGS.

FLUCTUATIONS OF WATER LEVELS IN SELECTED KEY WELLS
AND CUMULATIVE DEPARTURE FROM MONTHLY NORMAL PRECIPITATION FOR WISCONSIN



----- 30-year normal water level

After a 10-year period of above-normal precipitation, Wisconsin encountered three dry years in a row. During 1987-89, precipitation in most of Wisconsin was below normal for all three years. Only in counties along the Mississippi River and Lake Michigan and in south-central counties was precipitation recorded below normal for only two years (in a few cases only one year) of the three years. The map below shows that drought was particularly severe in the north -- in parts of northwestern, north-central, and northeastern Wisconsin -- where drought conditions occurred during all three years. In most of the remaining area of the state, drought conditions prevailed for at least two of the three years. Only in southeastern Wisconsin was precipitation more than 85 percent of normal for all three years.

The combination of mild winters, prolonged periods of deficient rainfall, and high summer temperatures (especially in 1988) caused crop-production problems for farmers and kept water levels in wells and lakes (including Lake Michigan) declining and streamflows low. It will take many weeks of above-normal rain to make up the moisture deficit in the soil and to reverse the declining groundwater levels. If the first part of the winter of 1989-90 is any indication, there will be little relief for declining water levels in 1990. Unseasonably cold temperatures and the lack of snow cover in December 1989 led to deeply frozen soil. If the ground stays deeply frozen, the snow-melt and spring rains may run off into streams instead of soaking into the ground and replenishing groundwater.

The outlook for 1990 is not optimistic. The Midwestern Climate Center in Champaign, Illinois, predicted that most of Wisconsin (except the SE region) has less than a 20 percent chance of recovering from the drought and that the hydrologic drought (which is measured by long-term water deficits) of 1988 and 1989 will continue well into 1990. That means that water levels in wells will stay below normal during 1990, unless we receive enough spring rains to replenish groundwater.

