Circular 182

Water-Level Trends and Pumpage in the Deep Bedrock Aquifers in the Chicago Region, 1991-1995

by Adrian P. Visocky
Office of Ground Water Resources Evaluation & Management

Illinois State Water Survey
A Division of the Illinois Department of Natural Resources

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Abstract: The deep bedrock aquifer system in northeastern Illinois is encountered at depths ranging from about 200 feet in areas of central northern Illinois to an average of about 1,000 feet below land surface at Chicago. The aquifers have a collective thickness of 300 to 1,300 feet in the Chicago region, averaging 700 feet. They are composed chiefly of sandstones and dolomites, although most of the water is derived from the sandstone units. Pumpage from deep bedrock wells for public and self-supplied industrial supplies in the Chicago region increased from 200,000 gallons per day (gpd) in 1864 to a peak withdrawal of 182.9 mgd in 1979. Between 1991 and 1994, pumpage decreased from 112.7 mgd to 67.1 mgd, mostly due to a shift to Lake Michigan water, particularly in DuPage County. As a result, water levels in deep wells rose between 1991 and 1995, particularly in southern Lake, eastern DuPage, and western Cook Counties. Average annual water-level rises during the four-year period varied from one foot in Kendall County to 38 feet in DuPage County and averaged about 14 feet. This marked the first time that average water-level changes were upward in all eight counties of the Chicago area since detailed record-keeping began in the 1950s.

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Indexing Terms: Chicago, northeastern Illinois, Cook County, Lake Michigan diversion, Lake Michigan allocations, aquifers, Cambrian-Ordovician aquifers, deep sandstone wells, deep bedrock aquifers, ground water, public water supplies, water levels, potentiometric surface, water-level changes, pumpage, ground-water withdrawals, practical sustained yield.

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WATER-LEVEL TRENDS AND PUMPAGE IN THE DEEP BEDROCK AQUIFERS IN THE CHICAGO REGION, 1991-1995

by
Adrian P. Visocky

SUMMARY

This report considers pumpage and water-level changes from 1991-1995 in deep bedrock wells penetrating the Cambrian and Ordovician aquifers in northeastern Illinois. These aquifers are the most highly developed system for large ground-water supplies in Illinois. Collectively, this system has been described as the "Cambrian-Ordovician aquifer" in earlier reports, but formal hydrostratigraphic unit names, reported by Visocky et al. (1985), have designated this system as the "Midwest Bedrock Aquigroup." An informal term, "deep bedrock aquifers," is used in this report for convenience.

The deep bedrock aquifer system is encountered at depths ranging from about 200 feet below the land surface in areas of north-central Illinois to an average of about 1,000 feet at Chicago. The aquifers have a collective thickness of 300 to 1,300 feet in the Chicago region, averaging 700 feet, and are composed chiefly of sandstones and dolomites. Most of the water is derived from the sandstone units. This report emphasizes the eight counties of the Chicago metropolitan area: Cook, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will.

Pumpage from deep bedrock wells for public and self-supplied industries in the Chicago region increased from 200,000 gallons per day (gpd) in 1864 to 175.9 million gallons per day (mgd) in 1980. Peak pumpage of 182.9 mgd occurred in 1979. As a result of the pumpage, artesian pressure in the deep bedrock aquifers declined more than 850 feet at Chicago. By 1994, pumpage had declined to 67.1 mgd and was concentrated in the Joliet area of Will County and in eastern Kane, northeastern Grundy, western Cook, and eastern McHenry Counties.

During the period from 1980-1985, pumpage from deep wells in the Chicago region dropped from 175.9 to 157.7 mgd, a decrease of 18.2 mgd or 10.3 percent. This was the first extended period of decreased pumpage from deep wells in the area since the post-depression, pre-World War II period. Pumpage continued to decline from 1985-1991, but at a rate that was double that of the 1980-1985 period. Between 1991 and 1994 the rate of decline in deep pumpage doubled again, falling from 112.7 mgd to 67.1 mgd, a rate of decline of 15.2 mgd per year. Most of the decline, about 27.5 mgd, occurred between 1991 and 1992 due to shifts in deep pumpage in DuPage and Lake Counties to Lake Michigan water and in Kane County to the Fox River.

Implementation of Lake Michigan allocations in DuPage County and parts of Lake County, in 1992, caused a significant decrease in deep pumpage in those counties and a shift in the location of the major pumping centers away from their traditional locations. Outside the Chicago region, heavy pumpage from deep wells occurred at Rockford in southeastern Winnebago County, Ottawa-Peru in central and west-central LaSalle County, DeKalb-Sycamore in central DeKalb County, Rochelle in southeastern Ogle County, and Belvidere in south-central Boone County.

As a result of the shift to other sources of water, levels in deep wells in most areas of the Chicago region rose sharply between 1991 and 1995, particularly in the western Cook-eastern DuPage County and northern Cook-southern Lake County areas. Elsewhere, significant declines occurred in parts of the Fox Valley in Kane County, in an industrial well in McHenry County, and in some wells at Joliet in Will County. On average, however, water levels rose in all eight counties in the Chicago region. Average annual water-level rises during the four-year period varied from one foot in Kane and Kendall Counties to 45 feet in DuPage County, with an average overall rise of about 15 feet. This overall rise in water levels continued the positive trend begun in the 1985-1991 period, following a continued record of declines since detailed record-keeping began in the 1950s.

With the shift of water supplies from deep wells to surface water or shallower aquifer sources, total deep pumpage in the Chicago region in 1994 was within three percent of the practical sustained yield.

INTRODUCTION

In May 1959, the Illinois State Water Survey and the Illinois State Geological Survey published Cooperative Ground-Water Report 1 (Suter et al., 1959), which discussed the geology and hydrology of the ground-water resources of the Chicago region, the yields of aquifers, and the possible consequences of future ground-water development. Special emphasis was placed on the deep bedrock aquifers which have been most widely used for large ground-water supplies. Cooperative Report 1 indicated that pumpage from deep wells during 1958 approached the amount that could be continuously withdrawn without eventually dewatering the most productive formation of the deep bedrock aquifers. Future water-level declines (1958-1980) were predicted, ranging from 190 feet at Elgin to 300 feet at Chicago and Des Plaines. It was recognized that actual water-level declines would vary from the predicted declines, if future distribution and pumpage rates deviated from extrapolations of past ground water used.

In 1959, as a result of the findings of Cooperative Report 1, the Water Survey expanded its program of collecting and reporting water-level and pumpage data for deep wells in the Chicago region. The objectives of the program were: 1) to provide long-term continuous records of pumpage and water-level fluctuations, 2) to delineate problem areas, and 3) to report hydrologic information to facilitate the planning and development of water resources of the deep bedrock aquifers in the Chicago region. The importance of the program became apparent during the ensuing years because of the increasing demands for water and the continuing decline of ground-water levels.

The Water Survey has issued many reports on water levels and pumpage from deep wells since the publication of Cooperative Report 1: Circular 79 (Walton et al., 1960); and Circulars 83, 85, 94, 113, 125, 154, 166, and 177 (Sasman et al., 1961, 1962, 1967, 1973, 1977, 1982, 1986; Visocky, 1993). These reports summarized data for 1959, 1960, 1961, 1962-66, 1966-1971, 1971-1975, 1971-1980, 1980-1985, and 1985-1991, respectively. Reports of Investigation 50 (Sasman, 1965) and 52 (Sasman and Baker, 1966) summarized data on ground-water pumpage in 17 northern Illinois counties through 1962 and 1963, respectively. Report of Investigation 73 (Sasman et al., 1974) discussed ground-water pumpage in 20 northern Illinois counties during the period 1960-1970. Reports of Investigation 83 (Schicht et al., 1976) and 97 (Singh and Adams, 1980) described available ground-water and surface water resources for the Chicago region, predicted water shortages depending on various water-use schemes, and offered alternatives for meeting projected water-supply needs to the year 2010. Contract Report 292 (Visocky, 1982) and Research Report 119 (Burch, 1991) described the impact of additional Lake Michigan withdrawals on deep-well pumpage and water-level trends. Cooperative Ground-Water Report 10 (Visocky et al., 1985) provided an updated hydrogeologic evaluation of the water resources of the deep bedrock aquifers.

In response to expanding urban development, the increasing use of lake water and other sources for public supplies, and growing interest in regional water resources development, this report provides a detailed discussion of ground-water withdrawals and water-level trends in northeastern Illinois. The report covers a 15-county area from Lake Michigan to north-central Illinois and from the Wisconsin border south to Kankakee County. Particular emphasis, however, has been given to the eight counties of the Chicago region because of the significant shift in pumpage from the deep bedrock aquifers to Lake Michigan and other sources in this region and water-level changes due to increasing ground-water withdrawals in some areas and decreasing withdrawals in others.

During spring 1992, major new Lake Michigan allocations were implemented in DuPage County, and many deep well pumps were turned off. Significant switches to lake water and other shallow sources also occurred in Cook, Kane, and Lake Counties since the last water-level measurement in fall 1991. This report describes the detailed water-level measurement made in the fall of 1995 and documents the response of the deep bedrock aquifers to major reductions of pumpage resulting from the switch to other water sources in those four counties.

Pumpage figures for the period, 199l-1994 (1995 figures were incomplete), used in this report, were taken from the Illinois Water Inventory Program, which gathers water-use information from questionnaires filled out by public water-supply operators and self-supplied industries. Since these data have not yet been published formally and are subject to final revisions, they must be considered preliminary.

In this report, pumpage for public use includes use by municipalities, subdivisions, mobile home parks, and institutions. No attempt has been made to determine the final use of water within these categories. Available records indicate that 111 public water supplies obtained water from deep wells in 1994, compared to 105 in 1991.

Pumpage for self-supplied industries includes only pumpage from wells owned and operated by the industries. (For convenience, country clubs are included in this category in this report.) Records indicate that at least 107 self-supplied industries in the Chicago region used deep wells in 1994, compared to 85 in 1991.

This report does not include pumpage from deep wells for individual domestic and rural residences or for farm supplies. Few wells serve these uses in the Chicago region, and total estimated pumpage for these uses in northeastern Illinois is extremely limited.

Water levels in deep wells were measured by a variety of methods and under a wide range of operating conditions and reliability. Most measurements were taken with altitude gages attached to air lines permanently suspended in the wells. Other measurements were obtained with graduated steel tapes or electric droplines that set off either light or sound signals when the probe touches water. A few wells are open holes and can be measured very accurately. Most wells, however, are equipped with pumps that limit or prevent access for measurement. Water levels are affected by recent pumpage of the well itself or by pumpage at adjacent wells. The reliability of the water-levelmeasuring equipment and the experience of the person taking the measurement are also important considerations. Altitude gages, for example, are generally limited to a precision of about a foot, while steel tapes and electric droplines can be read with a precision of as much as 0.01 foot and 0.02 foot, respectively.

The eight counties of the Chicago region, with abbreviations used in this report, are:

Cook	COK	Kendall	KEN
DuPage	DUP	Lake	LKE
Grundy	GRY	McHenry	MCH
Kane	KNE	Will	WIL

The seven northern counties outside of the Chicago region included in this report are:

Boone	BNE	Lee	LEE
DeKalb	DEK	Ogle	OGL
Kankakee	KNK	Winnebago	WIN
LaSalle	LAS		

Acknowledgments

Partial support for the fall 1995 field data collection described in this report was provided by the Illinois Department of Natural Resources, Office of Water Resources. The author wishes to acknowledge the numerous individuals and organizations who generously contributed information incorporated in this report. Operators of more than 85 percent of the public and self-supplied industrial water-supply systems reported their annual pumpage in response to mailed questionnaires. Water-level data were largely obtained during visits of Illinois State Water Survey personnel to system operators. Retired former employees of the Water Survey, Curtis Benson and Robert Sasman, collected the water-level data. Kris Klindworth supplied pumpage information and statistics from the Illinois Water Inventory Program and developed mailing lists for contacting water-supply operators. Dorothy Woller provided data and statistics about the status of deep bedrock production wells. Sean Sinclair generated base maps and preliminary computer interpretations of water-level data. Eva Kingston provided editorial review, Linda Hascall provided graphical support, and Pamela Lovett did the word processing.

GEOLOGY AND HYDROLOGY

Ground-water resources in the Chicago region are developed mainly from three aquifer systems: 1) sand-and-gravel deposits of the glacial drift; 2) shallow dolomite formations, mainly of Silurian age; and 3) deep sandstone and dolomite formations of Cambrian and Ordovician age, of which the Ironton-Galesville Sandstone is the most productive. Supplemental yields are obtained from a diminishing number of wells that still penetrate the Elmhurst-Mt. Simon aquifer, a very thick sandstone aquifer that is separated from the overlying Ironton-Galesville Sandstone by the shales, siltstones, and dolomites of the Eau Claire Formation. The sequence, structure, and general characteristics of these rocks are shown in figures 1 and 2.

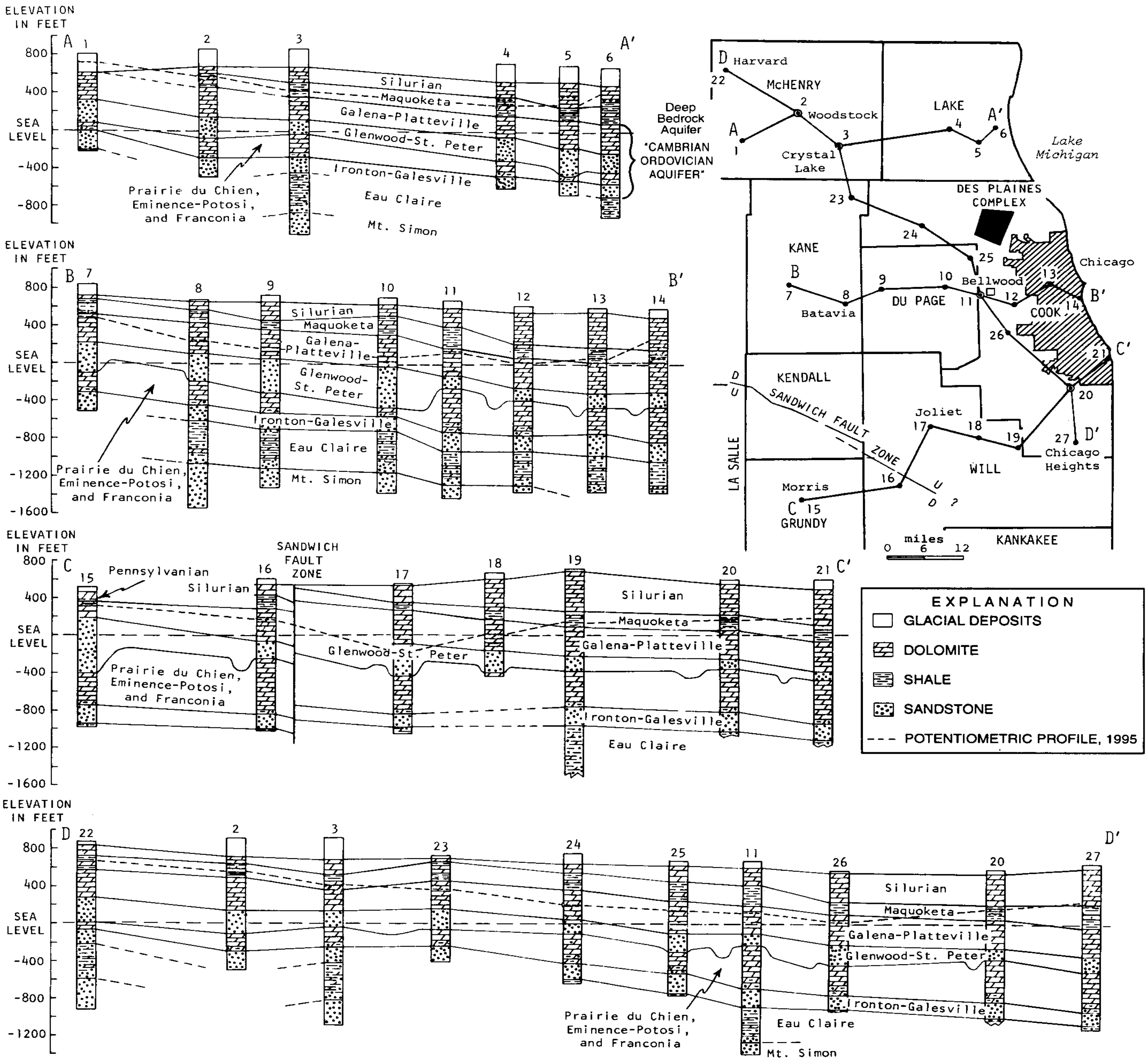

Figure 1. Bedrock cross sections and stratigraphy and potentiometric profile of the deep bedrock aquifers in the Chicago region (after Suter et al., 1959)

SYSTEM	SERIES AND MEGAGROUP	GROUP AND FORMATION	HYDROSTRATIGRAPHIC UNITS: Aquigroup	HYDROSTRATIGRAPHIC UNITS: aquifer/aquitard	LOG	THICKNESS (ft)	DESCRIPTION
Quaternary	Pleistocene	Undifferentiated	Prairie	Pleistocene		0 – 600	Unconsolidated glacial deposits - pebbly clay (till) silt, and gravel. Loess (windblown silt), and alluvial silts, sands and gravels.
Tertiary & Cretaceous		Undifferentiated	Prairie			0 –100	Sand and silt.
Carboniferous – Pennsylvanian		Undifferentiated	Upper Bedrock – Mississippi Valley	Pennsylvanian		0 – 500	Mainly shale with thin sandstone, limestone, and coal beds.
Carboniferous – Mississippian	Valmeyeran	St. Louis Ls Salem Ls Warsaw Ls Keokuk Ls Burlington Ls	Upper Bedrock – Mississippi Valley	St. Louis - Salem aquifer Keokuk - Burlington aquifer		0 – 600	Limestone; cherty limestone; green, brown, and black shale; silty dolomite.
Carboniferous – Mississippian	Kinderhookian	Undifferentiated	Upper Bedrock – Mississippi Valley				
Devonian		Undifferentiated	Upper Bedrock – Mississippi Valley	Devonian		0 – 400	Shale, calcareous; limestone beds, thin.
Silurian	Niagaran	Port Byron Fm Racine Fm Waukesha Ls Joliet Ls	Upper Bedrock – Mississippi Valley	Silurian dolomite aquifer		0 – 465	Dolomite, silty at base, locally cherty.
Silurian	Alexandrian	Kankakee Ls Edgewood Ls	Upper Bedrock – Mississippi Valley	Silurian dolomite aquifer			
Ordovician	Cincinnatian	Maquoketa Shale Group	Upper Bedrock – Midwest Bedrock	Maquoketa confining unit		0 – 250	Shale, gray or brown; locally dolomite and/or limestone, argillaceous.
Ordovician	Mohawkian – Ottawa Ls Megagroup	Galena Group Decorah Subgroup Platteville Group	Upper Bedrock – Midwest Bedrock	Galena-Platteville unit		0 – 450	Dolomite and/or limestone, cherty. Dolomite, shale partings, speckled. Dolomite and/or limestone, cherty, sandy at base.
Ordovician	Mohawkian / Chazyan	Ancell Gr: Glenwood Fm St. Peter Ss	Upper Bedrock – Midwest Bedrock	Ancell aquifer		100 – 650	Sandstone, fine- and coarse-grained; little dolomite; shale at top. Sandstone, fine- to medium-grained; locally cherty red shale at base.
Ordovician	Canadian – Knox Megagroup	Prairie du Chien Group: Shakopee Dol New Richmond Ss Oneota Dol Gunter Ss	Midwest Bedrock	Middle confining unit: Prairie du Chien		100 – 1300	Dolomite, sandy, cherty (oolitic), sandstone. Sandstone, interbedded with dolomite. Dolomite, white to pink, coarse-grained, cherty (oolitic), sandy at base.
Cambrian	St. Croixian – Knox Megagroup	Jordan Ss Eminence Fm–Potosi Dolomite	Midwest Bedrock	Middle confining unit: Eminence-Potosi			Dolomite, white, fine-grained, geodic quartz, sandy at base.
Cambrian	St. Croixian – Knox Megagroup	Franconia Fm	Midwest Bedrock	Middle confining unit: Franconia			Dolomite, sandstone, and shale, glauconitic, green to red, micaceous.
Cambrian	St. Croixian	Ironton Ss	Midwest Bedrock	Ironton-Galesville aquifer		0 – 270	Sandstone, fine- to medium-grained, well sorted, upper part dolomitic.
Cambrian	St. Croixian	Galesville Ss	Midwest Bedrock	Ironton-Galesville aquifer			
Cambrian	St. Croixian	Eau Claire Fm	Basal Bedrock	Eau Claire		0 – 450	Shale and siltstone; dolomite, glauconitic; sandstone, dolomitic, glauconitic.
Cambrian	St. Croixian	Mt. Simon Fm	Basal Bedrock	Elmhurst-Mt. Simon aquifer		0 – 2600	Sandstone, coarse-grained, white, red in lower half; lenses of shale and siltstone, red, micaceous.
Pre-Cambrian			Crystalline				No aquifers in Illinois

Note: The rock-stratigraphic and hydrostratigraphic-unit classifications follow the usage of the Illinois State Geological Survey.

Figure 2. Stratigraphy and water-yielding properties of the rocks and the character of the ground water in northeastern Illinois (after Visocky et al., 1985)

DRILLING AND CASING CONDITIONS	WATER-YIELDING PROPERTIES	CHEMICAL QUALITY OF WATER	WATER TEMPERATURE, °F
Boulders, heaving sand locally; sand and gravel wells usually require screens and development; casing in wells into bedrock.	Sand and gravel, permeable. Locally, wells yield as much as 3000 gpm. Specific capacities vary from about 0.1 to 5600 gpm/ft.	TDS generally between 400 and 600 mg/L. Hardness 300–400 mg/L. Iron generally 1–5 mg/L.	50 – 64
Shale requires casing.	Extremely variable. Sandstone and limestone units generally yield less than 10 gpm.	TDS extremely variable regionally and with depth. North-central Illinois, 500–1500 mg/L; southern, 500–3000 mg/L. Hardness: 150–400 mg/L north; 150–1000 mg/L south. Iron generally 1–5 mg/L.	53 – 57
	In southern two-thirds of state, yields generally less than 25 gpm.	TDS ranges between 400 and 1000 mg/L. Hardness is generally between 200 and 400 mg/L. Iron: 0.3–1.0 mg/L.	53 – 59
Upper part usually weathered and broken; crevicing varies widely.	Yields inconsistent. Major aquifer in NE and NW Illinois. Yields in fractured zones more than 1000 gpm.	TDS: 350–1000 mg/L; Hardness: 200–400 mg/L; Iron: 0.3–1.0 mg/L.	52 – 54
Shale requires casing.	Shales generally not water yielding. Crevices in dolomite units yield small local supplies.		
Crevicing commonly where formations underlie drift. Top of Galena usually selected for hole reduction and seating of casing.	Where overlain by shales, crevicing and well yields small. Where overlain by drift, wells yield moderate quantities of water.		
Lower cherty shales cave and are usually cased. Friable sand may slough.	Small to moderate quantities of water. Transmissivity approximately 15 percent of that of the Midwest Bedrock Aquigroup.	For Midwest Bedrock Aquigroup as a whole, TDS ranges from 400 to 1400 mg/L in NW and up to 2000 mg/L in south. Hardness ranges from 175 mg/L in northern recharge areas to 600 mg/L in E. Cook and S. Fulton Counties. Iron generally less than 1.0 mg/L.	52 – 73
Crevices encountered locally in the dolomite, especially in the Eminence-Potosi. Casing not required.	Crevices in dolomite and sandstone yield small to moderate quantities of water. Transmissivity approximately 35 percent of that of the Midwest Bedrock Aquigroup.		
Amount of cementation variable. Lower part more friable. Sometimes sloughs.	Most productive unit of the Midwest Bedrock Aquigroup. Yields over 500 gpm common in northern Illinois. Transmissivity approximately 50 percent of that of the Midwest Bedrock Aquigroup.		
Casing not usually necessary. Locally weak shales may require casing.	Shales generally not water yielding.		
Casing not required.	Moderate quantities of water in upper units. Comparable in permeability to the Glenwood-St. Peter Sandstone.	Varies northwest to southeast and with depth. At shallower depths, TDS: 235–4000 mg/L. Hardness: 220–800 mg/L. Iron: 0.1–20 mg/L. High chloride concentrations with depth.	51 - 62 in the north, 80 or more in the south

Figure 2. Concluded

The sequence of rocks that make up the Cambrian and Ordovician units described in this report were first defined by Suter et al. (1959) as the “Cambrian-Ordovician Aquifer” and have been referred to by this name in most subsequent reports. A local term, “deep sandstone aquifer,” is often used informally in northeastern Illinois in reference to the two major sandstone aquifers within the deep bedrock system. Visocky et al. (1985) introduced formal hydrostratigraphic names first proposed by Cartwright (1983) in describing major aquifers, in order to reduce confusion with rock stratigraphic terminology. The name “Midwest Bedrock Aquigroup” was suggested for the sequence of rocks from the Maquoketa Shale Group (the top of the overlying confining layer) to the top of the Eau Claire Formation (the underlying confining layer). Since this formal terminology is not familiar to most readers and has not as yet been formally adopted by the scientific community, an informal description, “deep bedrock aquifers,” will be used in this report.

The deep bedrock aquifers consist of two major sandstone aquifers, the Ancell aquifer (composed of the Glenwood Formation and St. Peter Sandstone) and the Ironton-Galesville aquifer (composed of the Ironton and Galesville Sandstones). Separating these two aquifers is a confining unit made up mainly of dolomite and shale with some sandstone.

The Ancell aquifer is present throughout northeastern Illinois and frequently exceeds 200 feet in thickness. In some sections of north-central Illinois, faulting and erosion have placed this aquifer immediately below the glacial drift. The majority of public and industrial wells finished in the Ancell aquifer in the Chicago region produce less than about 200 gallons per minute (gpm). In north-central Illinois, however, the Ancell aquifer yields several hundred gpm to wells and is the primary source of ground water for some municipal and industrial supplies.

The Prairie du Chien, Eminence-Potosi, and Franconia Formations underlie the Ancell aquifer and constitute the “middle confining unit” above the Ironton-Galesville aquifer. The formations of the confining unit are present throughout much of northern Illinois, although the upper units have been eroded extensively in the north. In some areas, these formations provide moderate amounts of water to wells tapping the deep bedrock aquifers.

The Ironton-Galesville aquifer underlies the Franconia Formation and overlies the Eau Claire Formation, another confining unit. It occurs throughout northeastern Illinois, and on a regional basis it is the most consistently permeable and productive unit of the deep bedrock aquifers. Most of the high-capacity deep municipal and industrial wells in the Chicago region obtain a major part of their yields from this aquifer.

Prior to the switch to Lake Michigan water, supplemental yields were obtained from wells penetrating the Elmhurst-Mt. Simon aquifer, particularly in parts of western and northwestern Cook County, eastern Kane County, parts of DuPage and Lake Counties, the Joliet area of Will County, and farther west in Ogle and Winnebago Counties. A major problem with the Elmhurst-Mt. Simon aquifer is the possibility of obtaining water high in chloride concentrations. In the Chicago region, water below an elevation of about 1,300 feet below sea level (msl) is commonly too salty for municipal or industrial use. Over the years, heavy pumping of the deep bedrock aquifers has gradually degraded the water quality in some areas by inducing upward migration of highly mineralized water from the deeper sections of the Elmhurst-Mt. Simon aquifer. The potentiometric surface of the Ironton-Galesville aquifer is lower than that of the Elmhurst-Mt. Simon aquifer, causing the upward movement of the poorer quality water. Numerous wells in Cook, DuPage, and Kane Counties, originally drilled into the Elmhurst-Mt. Simon aquifer, have since been plugged above these formations to exclude this poor-quality water.

The primary source of recharge to the deep bedrock aquifers is precipitation, which percolates through the glacial deposits where the Galena-Platteville dolomite or older rocks are the uppermost bedrock formation. This area is defined essentially by the western limits of the Maquoketa Shale Group and, to a small extent, by the northern limits of the Pennsylvanian-age shales. It encompasses major portions of north-central and northwestern Illinois. The Maquoketa shales are the primary overlying confining material in the Chicago region, along with the underlying Galena-Platteville unit, which locally yields small quantities of water.

Until recently, heavy ground-water withdrawals over the years had lowered water levels at the major pumping centers and established steep hydraulic gradients north, west, and southwest of Chicago and Joliet. As a result, large quantities of water from recharge areas in northern Illinois and relatively minor quantities from southeastern Wisconsin were transmitted toward pumping centers, along with small amounts derived from vertical leakage downward through the Maquoketa and Galena-Platteville units (Walton, 1960). Because of the overpumpage, water derived from storage within the deep bedrock aquifers supplemented the water moving horizontally or vertically, and it, too, moved toward the cones of depression in the potentiometric surface. In recent years, as pumpage from deep bedrock wells has lessened in favor of shallower sources, water levels have undergone a redistribution in which former cones of depression have disappeared and new, smaller cones have begun to develop and grow in outlying areas. However, because water levels in the former cones ofdepression are still recovering, established patterns of ground-water flow from recharge areas inward toward the Chicago area continue. In addition, lesser amounts of water are derived from the south in Illinois, from the southeast in Indiana, and from the northeast beneath Lake Michigan.

PRODUCTION FROM DEEP BEDROCK WELLS

The first deep well in northern Illinois was drilled in Chicago in 1864. It had an artesian flow at ground surface estimated at 150 gpm, or about 200,000 gpd. A considerable number of deep wells were in operation in the Chicago region by 1900, and pumpage was estimated at 23 mgd. Pumpage increased at a rather irregular rate during the first half of the twentieth century and reached 75.6 mgd in 1955, as shown in figure 3. During the succeeding 24 years, pumpage for public and industrial uses increased dramatically by 142 percent at an average rate of 4.5 mgd per year. It reached an all-time high of 182.9 mgd in 1979. Public and industrial pumpage dropped to 175.9 mgd in 1980, 157.7 in 1985, 112.7 mgd in 1991, and 67.1 mgd in 1994 (as this report went to press, complete pumpage figures for 1995 were not yet available).

Pumpage, 1991-1994

The period from 1980 to 1985 saw the first overall decline in pumpage, at a rate of 3.6 mgd per year since the peak pumpages of the late 1970s. This decline continued during the period from 1985 to 1991, but at a steeper rate—7.5 mgd per year—double the rate of decline of the previous five years. The previous rate of decline doubled again during the 1991-1994 period—15.2 mgd per

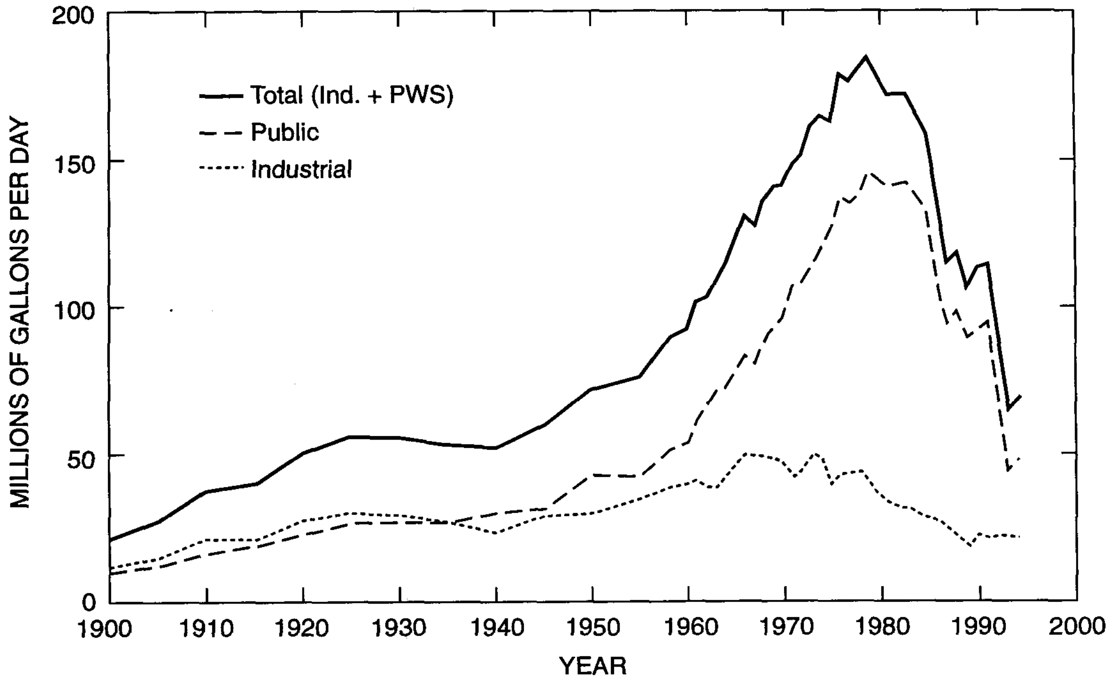

Figure 3. 1900-1994 production from the deep bedrock aquifers in the eight-county Chicago region, subdivided by use

year. The largest part of the decline—27.5 mgd—occurred between 1991 and 1992 and was attributable to a shift of public water supplies in DuPage and Lake Counties to Lake Michigan water and a partial shift in Kane County to the Fox River. Between 1992 and 1993 another large decline occurred—22.8 mgd—attributable to shifts in public water-supply sources in DuPage and Lake Counties, but also in Cook County. Total pumpage then rose slightly in 1994 to 67.1 mgd.

Other reasons for the pumpage fluctuations between 1985 and 1991 were a combination of several factors. They include climate (water use rises during warm, dry periods), shifts in population, and the replacement of deep bedrock wells with shallower wells in order to meet the Safe Drinking Water Standards for radium and barium (USEPA, 1976, 1991).

During the period 1991-1994, pumpage for public and industrial supplies from deep bedrock wells declined from 112.7 to 67.1 mgd. Total pumpage in 1993 was 63.3 mgd, the smallest deep bedrock well pumpage since sometime in the 1945-1950 period. Table 1 shows the distribution of pumpage in the eight-county Chicago region between 1991 and 1994, subdivided by public and industrial use categories and by counties.

Ground-water production from the deep bedrock aquifers decreased in all counties but McHenry and Will in amounts ranging from 30.3 mgd in DuPage County to 0.4 mgd in Kendall County. Production in McHenry and Will Counties increased by 3.1 mgd and 0.3 mgd, respectively.

Production for public supplies decreased 46.1 mgd during the period 1991-1994 and was 46.6 mgd in 1994, which represents 69 percent of the total deep bedrock production in the Chicago region. Self-supplied industrial water use increased 0.6 mgd or 3 percent during this period to 20.5

Table 1. 1985-1994 Distribution of Pumpage from Deep Bedrock Wells in Northeastern Illinois, Subdivided by Use and County (millions of gallons per day)

Year	*County*	*Public*	*Industrial*	*Total*
1985	COK	48.67	8.72	57.39
	DUP	31.60	0.29	31.89
	GRY	2.11	7.26	9.37
	KNE	22.01	0.39	22.40
	KEN	0.92	0.32	1.74
	LKE	7.54	1.16	8.70
	MCH	3.26	1.28	4.54
	WIL	14.81	6.88	21.69
	Total	**130.92**	**26.80**	**157.72**
1986	COK	27.08	6.44	33.52
	DUP	29.01	0.06	29.06
	GRY	2.13	8.63	10.76
	KNE	21.58	0.43	22.01
	KEN	0.91	0.68	1.59
	LKE	6.89	1.30	8.19
	MCH	3.05	1.27	4.32
	WIL	14.50	6.95	21.45
	Total	**105.15**	**25.76**	**130.91**
1987	COK	12.40	4.51	16.91
	DUP	31.17	0.04	31.21
	GRY	2.23	8.09	10.32
	KNE	21.08	0.34	21.42
	KEN	0.94	0.51	1.45
	LKE	6.64	1.29	7.93
	MCH	2.98	1.16	4.14
	WIL	14.53	6.18	20.71
	Total	**91.97**	**22.12**	**114.09**
1988	COK	11.70	5.83	17.53
	DUP	32.37	0.06	32.43
	GRY	2.59	5.71	8.30
	KNE	22.89	0.37	23.26
	KEN	1.24	0.33	1.57
	LKE	7.89	0.33	8.22
	MCH	3.25	1.58	4.83
	WIL	15.41	5.57	20.98
	Total	**97.34**	**19.78**	**117.12**

Table 1. Continued

Year	*County*	*Public*	*Industrial*	*Total*
1989	COK	11.06	4.56	15.62
	DUP	30.74	0.07	30.81
	GRY	0.99	6.47	7.46
	KNE	18.99	0.23	19.22
	KEN	0.66	0.01	0.67
	LKE	7.45	0.99	8.44
	MCH	3.68	0.96	4.64
	WIL	14.00	4.12	18.12
	Total	**87.57**	**17.41**	**104.98**
1990	COK	10.27	4.04	14.31
	DUP	31.42	0.07	31.49
	GRY	2.61	7.75	10.36
	KNE	20.68	0.19	20.87
	KEN	0.90	0.31	1.21
	LKE	7.10	0.31	7.41
	MCH	3.16	1.26	4.42
	WIL	14.06	6.87	20.93
	Total	**90.20**	**20.80**	**111.00**
1991	COK	10.19	4.58	14.77
	DUP	33.80	0.08	33.88
	GRY	2.03	7.83	9.86
	KNE	20.92	0.20	21.12
	KEN	1.21	0.30	1.51
	LKE	7.90	0.32	8.22
	MCH	2.70	0.42	3.12
	WIL	13.98	6.22	20.20
	Total	**92.73**	**19.95**	**112.68**
1992	COK	11.00	2.55	13.55
	DUP	13.72	0.03	13.75
	GRY	2.26	7.95	10.21
	KNE	13.54	0.55	14.09
	KEN	1.08	0.30	1.38
	LKE	4.53	0.80	5.33
	MCH	2.64	1.99	4.63
	WIL	16.23	7.00	23.23
	Total	**65.00**	**21.17**	**86.17**

Table 1. Concluded

Year	*County*	*Public*	*Industrial*	*Total*
1993	COK	5.43	3.35	8.78
	DUP	2.80	0.02	2.82
	GRY	2.18	7.25	9.43
	KNE	11.60	0.44	12.04
	KEN	0.57	0.30	0.87
	LKE	2.10	0.48	2.58
	MCH	3.03	1.95	4.98
	WIL	15.14	6.69	21.83
	Total	**42.85**	**20.48**	**63.33**
1994	COK	6.81	3.38	10.19
	DUP	3.51	0.05	3.56
	GRY	2.14	6.82	8.96
	KNE	12.16	0.46	12.62
	KEN	0.80	0.33	1.13
	LKE	2.30	1.65	3.95
	MCH	4.24	2.01	6.25
	WIL	14.62	5.84	20.46
	Total	**46.58**	**20.54**	**67.12**

Note:
County names were abbreviated as follows: COK (Cook), DUP (DuPage), GRY (Grundy), KNE (Kane), KEN (Kendall), LKE (Lake), MCH (McHenry), and WIL (Will).

mgd in 1994. This represents approximately 31 percent of the deep well production, compared to 18 percent in 1991, i.e., with the shift of public water supplies to other sources, industrial pumpage represents a larger portion of the total deep bedrock water withdrawals.

Another interesting part of the deep bedrock water-use statistics is the number of new deep wells constructed and the number taken out of service and sealed. For examples, during the years 1991-1995, 43 new wells were drilled: 30 by public water systems and 13 by industries. By contrast, 49 deep wells were sealed: 41 by public water facilities and 2 by industries. Of the 41 public water wells abandoned, 32 were from Cook and DuPage Counties alone, reflecting the switch to Lake Michigan water.

Public Pumpage

Public pumpage declined by 50 percent between 1991 and 1994, from 92.7 mgd to 46.6 mgd. In 1993, public pumpage was even lower: at 42.8 mgd. The biggest part of the decline occurred in 1992, when pumpage fell to 65.0 mgd, a decline of 27.7 mgd or 60 percent of the total decline in the 1991-1994 period. The greatest decreases in public pumpage occurred in DuPage, Kane, Lake, and Cook Counties, which dropped 30.3, 8.8, 5.6, and 3.4 mgd, respectively. The only significant increase, 1.5 mgd, occurred in McHenry County. Public pumpage in Grundy, Kendall, and Will Counties changed little from 1991 to 1994.

The number of major pumping centers (those in which facilities withdrew 1.0 mgd or more) decreased between 1991 and 1994. Records identify 26 major public water supply facilities in 1991. By 1994, this number had dropped to 16, of which the largest number (7) were in the Fox River valley of Kane County. Other major centers were two each in western Cook, western DuPage, and western Will Counties, and one each in northern Grundy, southern Lake, and eastern McHenry Counties. Pumpage at these major centers ranged from 1.0 to 10.8 mgd, as shown in table 2.

Ironically, records also indicate that the number of facilities using deep wells during this period actually increased overall: 111 public water facilities relied on deep wells in 1994, compared to 105 facilities in 1991. Since the number of major pumping centers declined over this period, the increase no doubt reflects an increase in smaller facilities, such as in subdivisions.

Table 2. Major Public Water-Supply Pumping Centers from Deep Bedrock Wells in the Chicago Region, 1994

Pumping Center	*Pumpage (mgd)*	*Pumping Center*	*Pumpage (mgd)*
Joliet	10.8	Batavia	1.4
Aurora	3.6	Bellwood	1.2
Crystal Lake	3.4	Elgin	1.2
West Chicago	1.9	Western Springs	1.2
Morris	1.9	St. Charles	1.2
Lake Zurich	1.8	Lockport	1.2
Montgomery	1.8	North Aurora	1.1
Bartlett	1.4	Geneva	1.0

Self-Supplied Industrial Pumpage

Self-supplied industries in the Chicago region withdrew 20.5 mgd of ground water from the deep bedrock in 1994, a slight increase from the 20.0 mgd withdrawn in 1991. Since 1991, pumpage ranged between 20.0 mgd and 21.2 mgd, and averaged 20.5 mgd. Actually, industrial withdrawals have been fairly consistent since about 1987, ranging between 17.4 mgd and 22.1 mgd, and averaging 20.3 mgd. The all-time highs for industrial pumpage from deep wells for the region were 48.1 mgd in 1966 and 48.2 mgd in 1973. Historically, comparably low industrial pumpage occurred in 1915, when withdrawals amounted to about 18.8 mgd. The only significant decreases in pumpage between 1991 and 1994 were in Cook County (1.2 mgd) and in Grundy County (1.0 mgd). Pumpage increased in Lake and McHenry Counties by 1.3 mgd and 1.6 mgd, respectively. Pumpage remained virtually the same in DuPage, Kane, Kendall, and Will Counties.

The major self-supplied industries in the Chicago region in 1994 were those producing organic chemicals, electric power, and food products. These industries accounted for 15 mgd or 73 percent of industrial pumpage. Other industries included irrigation systems; manufacturers of metals, construction machinery, telephone equipment, and boilers; and textile mills.

The number of industrial facilities using deep wells increased from 85 to 107 between 1991 and 1994. Six self-supplied industries pumped more than 1.0 mgd from deep wells in 1994, compared to three in 1991. Production from these six industries ranged from 1.1 to 5.0 mgd and totaled 13.6 mgd, accounting for 66 percent of the industrial deep well pumpage.

Pumpage Related to the Practical Sustained Yield

Schicht et al. (1976) estimated that the practical sustained yield of the deep bedrock aquifers, regardless of the scheme of well development, cannot exceed about 65 mgd. The practical sustained yield of the deep aquifers is defined as the maximum amount of water that can be withdrawn withouteventually dewatering the most productive water-yielding formation, the Ironton-Galesville Sandstone. The yield is largely limited by the rate at which water can move from recharge areas eastward through the aquifers to pumping centers. This movement, in turn, is dependent on the gradient of the potentiometric surface in the direction of flow. Schicht et al. (1976) suggested that the 65 mgd could be obtained by increasing the number of pumping centers, shifting some centers of pumping to the west, and spacing wells at greater distances *[in fact, with the abandonment of wells by facilities switching to Lake Michigan for water, the major pumping centers have, by default, shifted westward from the immediate Chicago area]*. Burch (1991) concluded from his digital computer model study of the aquifer system that the location of the pumping centers is less important than the *number* of centers, however.

Based on records of deep well production, the estimated practical sustained yield of the aquifer system was exceeded from sometime in the late 1940s through 1992. Burch (1991) had predicted that the switch to lake water in DuPage and Lake Counties in 1992 would reduce total withdrawals from deep wells to amounts at or below the practical sustained yield. Water-use information indicates that the total withdrawals for 1993 and 1994 were within three percent of the 65 mgd estimated by Schicht et al (1976). If pumpage remains close to this amount over the next five-year inventory period (1995-2000), water levels should gradually stabilize over most of the study area. The measurement of water levels in fall 2000, thus, would provide an opportunity to test the validity of the current practical sustained yield and to make ground-water resource management decisions as appropriate.

WATER LEVELS IN DEEP BEDROCK WELLS

The first deep bedrock well in Chicago was drilled in 1864 at 950 West Chicago Avenue, the corner of Chicago and Western Avenues (Leverett, 1899). The well was finished in dolomites of the lower part of the Galena and Platteville Groups. According to Leverett, *"This well was sunk by a band of Spiritualists with a view to prospecting for petroleum, and it is reported that the site of the well was determined by Mr. James, a so-called medium, while entranced. Only a small amount of oil was found, but at a depth of 711 feet a strong flow of water was struck, which rose to a height of 80 feet above the surface, or 111 feet above Lake Michigan."* Because it had such a high artesian pressure, the well flowed freely, as did many of the early wells in the region.

Suter et al. (1959) inferred that the potentiometric head of the water in the sandstone aquifers beneath the Galena and Platteville Groups was somewhat higher than in the overlying dolomite. At that time the average elevation of water levels in deep bedrock wells at Chicago and Joliet was about 700 feet above mean sea level (msl). As a result of continued heavy pumpage, by 1980, the nonpumping water levels had declined to elevations ranging from 150 feet above msl to more than 250 feet below msl at Arlington Heights in northern Cook County, at Bellwood in western Cook County, at Elmhurst in eastern DuPage County, and at Joliet in northwestern Will County. From 1864 to 1980, the potentiometric level at Chicago declined more than 850 feet (Sasman et al., 1986).

As described earlier, pumpage from deep bedrock wells peaked in 1979 and then began to diminish. Thus, by 1985, for the first time since detailed water levels were recorded, levels rose in a significant number of wells in the Chicago region. These rises were attributed to major shifts in the distribution of pumpage and to local reductions in pumpage between 1980 and 1985. Regionally, however, water levels continued to decline, especially in the major pumping centers. They were more than 225 feet below msl in some wells at Elk Grove, Elmhurst, and Joliet.

Pumpage continued to decline between 1985 and 1991, again mostly due to a shift to Lake Michigan water. As a result, water levels in many deep wells rose, particularly in northwestern Cook and southern Lake Counties. Average annual water-level changes during the six-year period were upward in five of the eight counties and varied from a rise of 12 feet in Cook County to a decline of 8 feet in Will County, with an overall average *rise* of about 3 feet. This marked the first time that the average change was upward since detailed record-keeping began in the 1950s.

Water-Level Changes in Observation Wells

Water levels were measured during fall 1995 in 539 deep wells in a 15-county area of northeastern Illinois. Data for these wells are given in the appendix. Water levels for 422 of these wells, including 279 in the eight-county Chicago region, had also been measured in 1991.

Figure 4 shows examples of changes in nonpumping water levels in selected deep bedrock wells in northeastern Illinois for the period 1975-1995, and figure 5 shows their locations. The hydrographs reflect both seasonal and long-term pumping trends. Declining water-level trends generally indicate increasing rates of local and regional pumpage, while rising trends indicate reduced rates of pumpage or long idle periods for well pumps.

Figure 6 shows water-level fluctuations and long-term trends since 1940 at a well in central Cook County (see also figure 5). The hydrograph indicates rapid declines in water levels during the 1950s and 1960s, reflecting dramatic increases in municipal and industrial dependence on the deep bedrock aquifers. Water-level declines continued through the 1970s and into the early 1980s although at slower rates. Water-level rises in this well began in the mid-1980s and have continued intermittently ever since, with total recoveries of 168 feet between 1983 and 1995. Decreased pumpage and increased reliance on water from Lake Michigan for public water supplies since 1980 have also slowed and even reversed the downward trend in water levels in many parts of the Chicago region, as reflected in many of the hydrographs in figure 4.

Table 3 shows average annual water-level changes in 11 observations wells in the eight-county Chicago region for the periods 1975-1980, 1980-1985, 1985-1991, and 1991-1995.

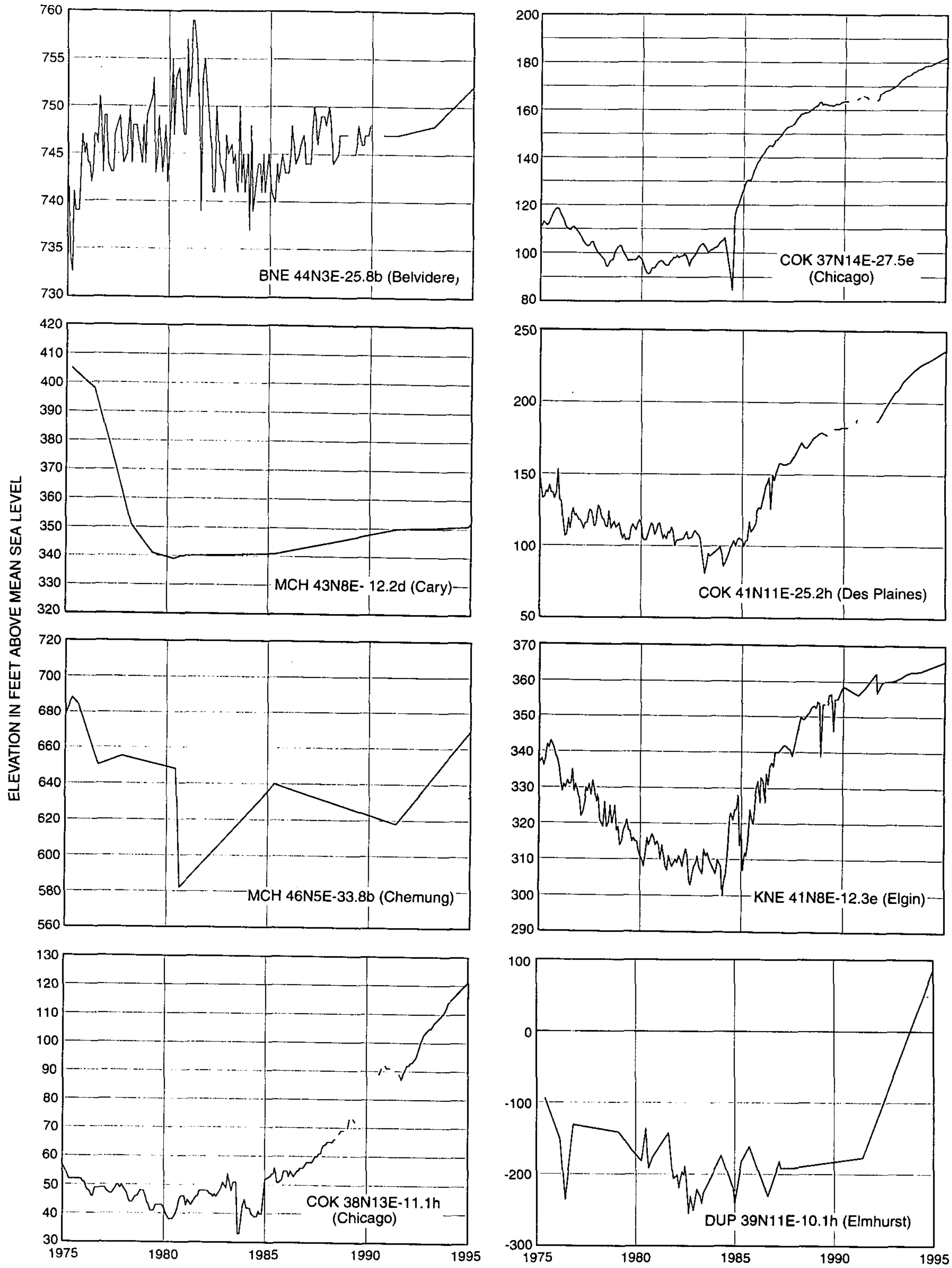

Figure 4. Water levels in selected observation wells in northern Illinois, 1975-1985

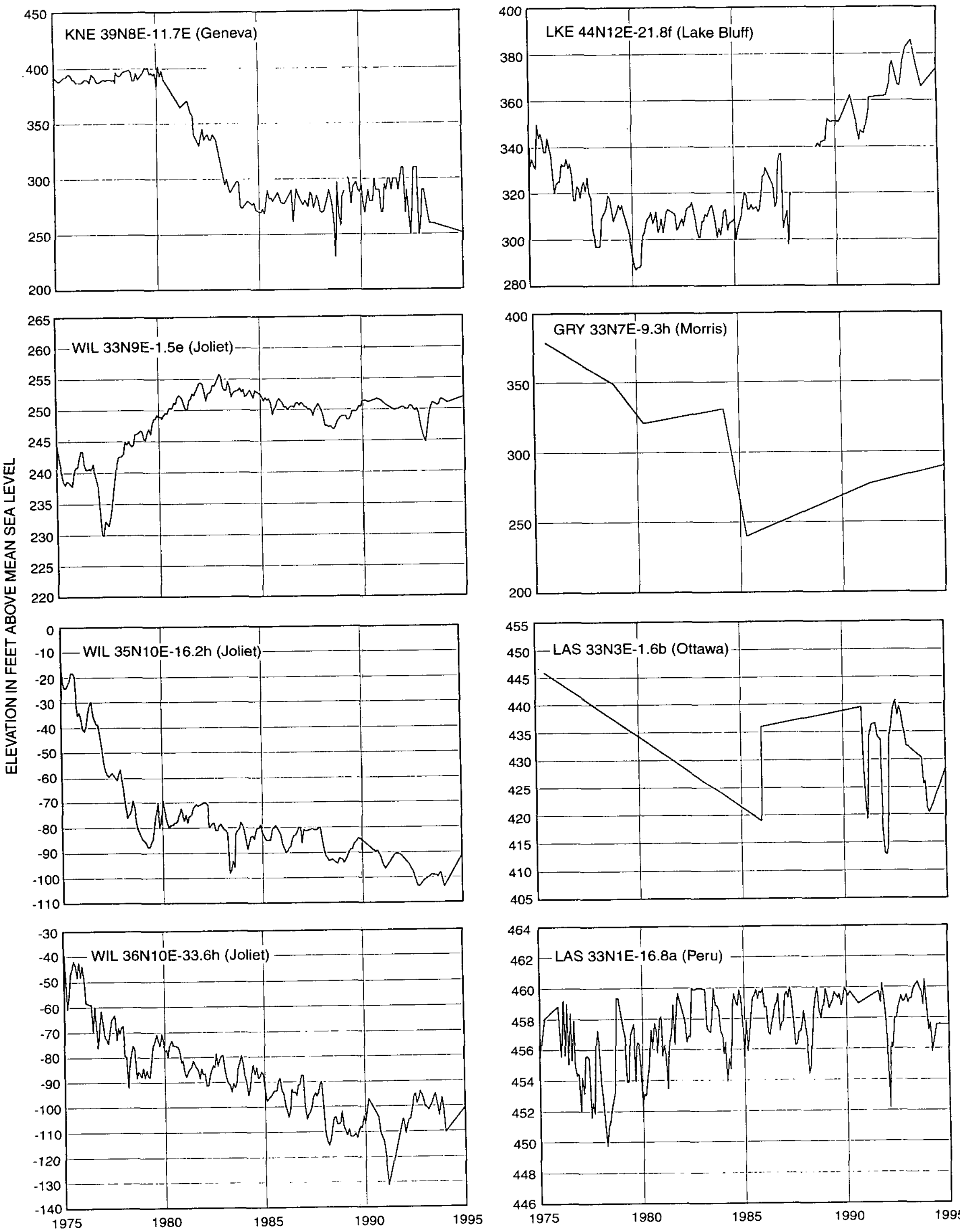

Figure 4. Continued

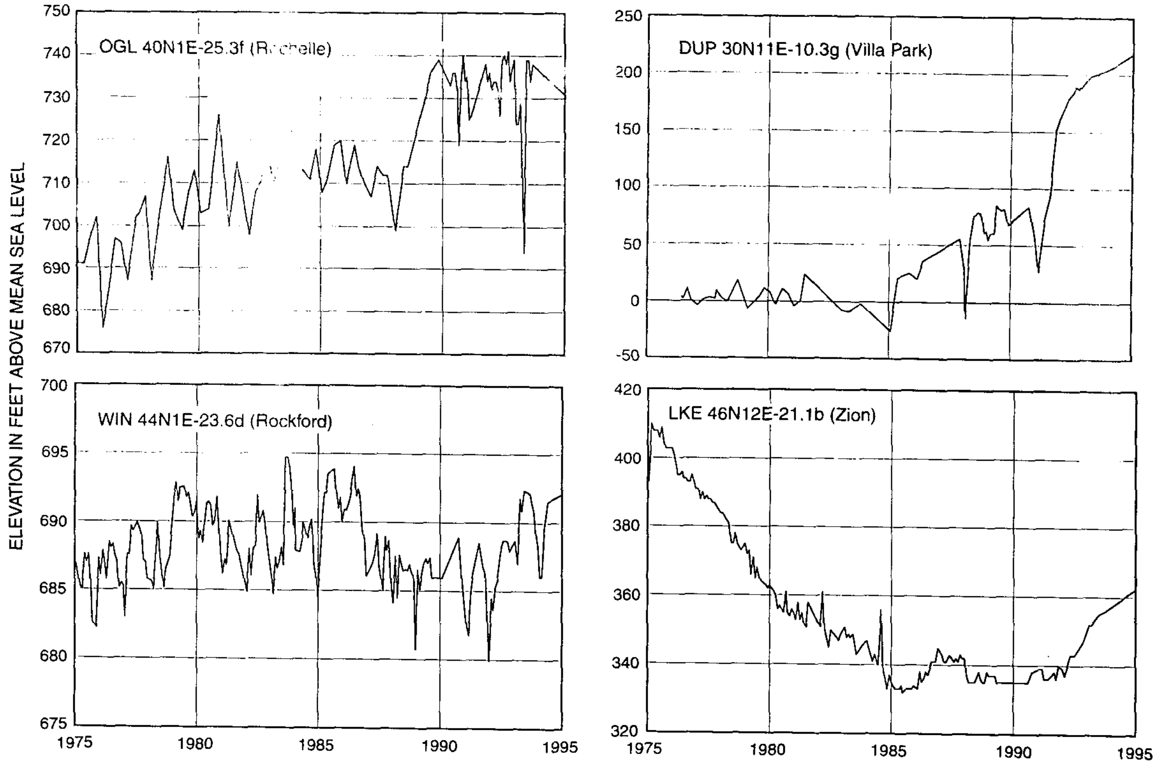

Figure 4. Concluded

1975-1980

For the period 1975-1980, average changes in the 11 observation wells shown in table 3 ranged from a rise of 2.2 feet per year (ft/yr) south of Joliet to a decline of 11.6 ft/yr in the center of Joliet. A total of 349 wells were measured in the Chicago region in both 1975 and 1980.

Water levels declined in 306 wells, rose in 40 wells, and no change was noted in 3 wells. Declines of 50 to 149 feet were recorded in 148 of the wells. Water-level rises of 52 to 80 feet were observed in four wells in Cook, Kane, and Will Counties; rises of 10 to 47 feet occurred in 22 of them.

1980-1985

Between 1980 and 1985, water-level changes in the 11 observation wells ranged from a rise of 8.0 ft/yr in the southern part of Chicago to a decline of 25.8 ft/yr. Water levels rose in six wells, declined in four wells, and no change was noted in one well. The dramatic change in levels at Geneva was attributed primarily to a change in the use of the observation well from an institutional supply with limited demand to a municipal supply with heavy demand. The upward trend in water levels noted at the well in south Chicago reflected the major shift of public water-supply systems in south Cook County from well water to lake water during that period.

Of the 364 wells measured in both 1980 and 1985, levels rose in 109 wells, declined in 250 wells, and stayed the same in five wells. Changes in water levels ranged from a rise of 265 feet for

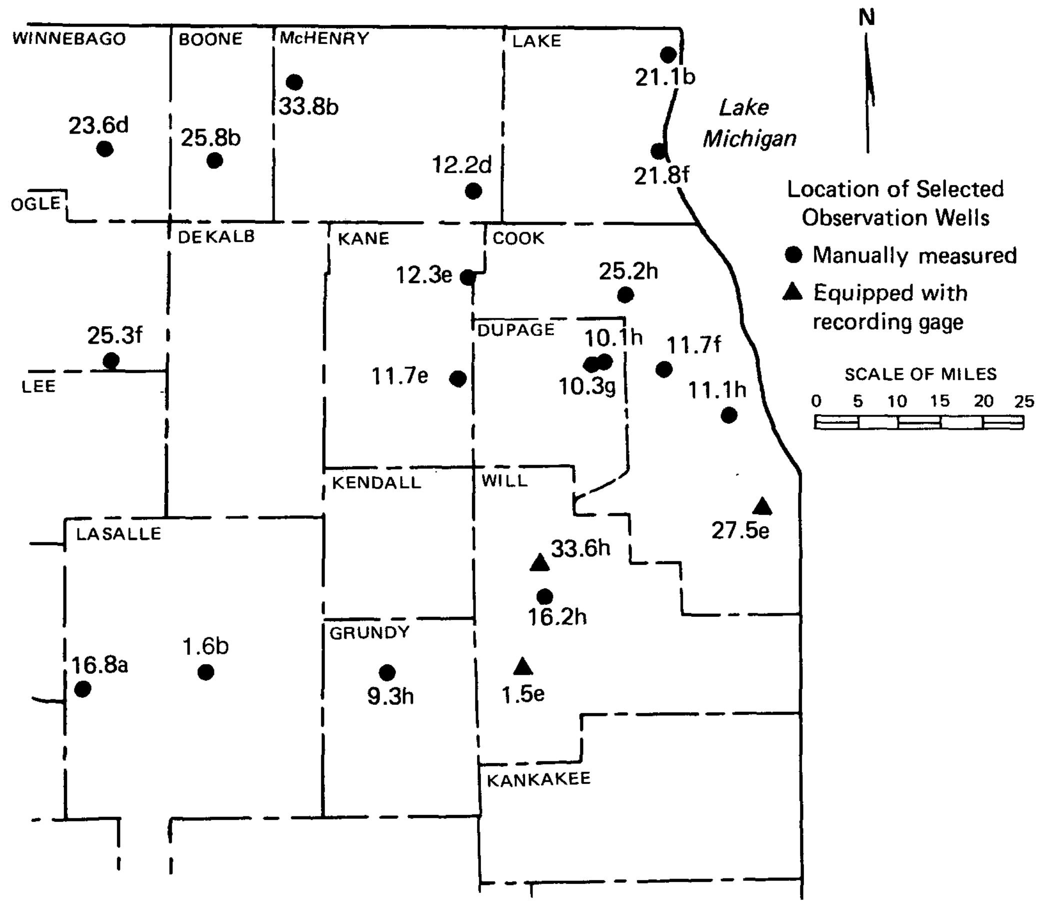

Figure 5. Location of selected wells for which hydrographs are shown in figures 4 and 6

one well in Lake County to a decline of 319 feet for one well in DuPage County. Both rises and declines were noted in all eight counties of the Chicago region.

1985-1991

From 1985 to 1991, average water-level changes in the 11 observation wells ranged from a rise of 11.5 ft/yr at Des Plaines to a decline of 6.3 ft/yr on the northern edge of Joliet. Rises occurred in eight of the wells, and declines were observed in three wells, all in the Joliet area.

Of the 320 wells that were measured in both 1985 and 1991, rises were observed in 174 wells (54.4 percent), declines in 140 wells (43.7 percent), and no change was seen in 6 wells (1.9 percent). This was a dramatic turnabout in proportions from the 1980-1985 figures, in which declines outnumbered rises by 68.7 to 29.9 percent. Rises and declines were observed in all eight of the counties, ranging from a rise of 218 feet in northern Cook County to a decline of 240 feet at Joliet.

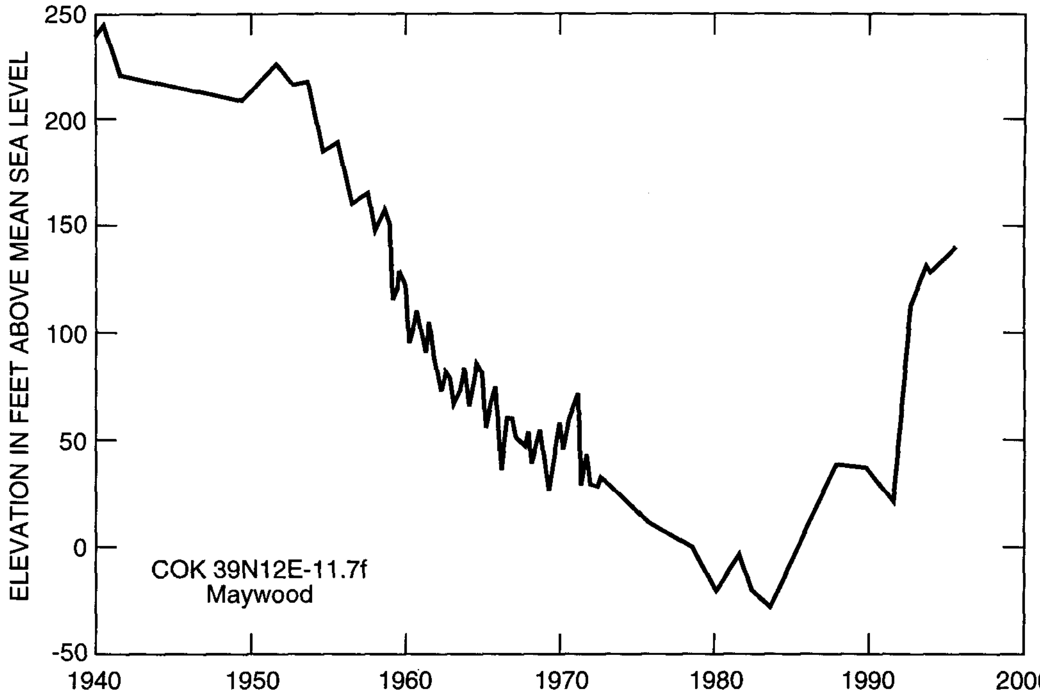

Figure 6. Representative trend of deep well water levels in Cook County since 1940

1991-1995

Between 1991 and 1995, average water-level changes in the 11 observation wells were all upward, with the exception of the well at Geneva. Water levels rose in these wells from 0.5 ft/yr south of Joliet to 30 ft/yr at Maywood, while water levels declined 16.5 ft/yr at Geneva.

Of the 364 wells that were measured in the eight-county Chicago region in fall 1995, 279 wells had also been measured in 1991. Water levels between 1991 and 1995 rose in 231 of these wells (83 percent), declined in 42 wells (15 percent), and showed no change in 6 wells (2 percent). This represents a considerable growth of the trend noted in the 1985-1991 period in which rises outnumbered declines by 54.4 to 43.8 percent. Rises and declines were observed in all eight of the Chicago-region counties, ranging from a rise of 320 feet in south-central Lake County to a decline of 190 feet in an industrial well south of Joliet. The largest percentages of rises were found in Cook, DuPage, Lake, and McHenry Counties, all with greater than 90 percent in rises, and the largest percentages of declines were found in Kane and Will Counties (36 and 30 percent).

Water-Level Changes - Regional Trends

Eight-County Chicago Region

A Chicago-region, county-by-county comparison of temporal water-level trends can be seen by comparing average annual water-level changes for the periods 1975-1980, 1980-1985, 1985-1991, and 1991-1995 (table 4).

Table 3. Average Changes in Nonpumping Water Levels in Selected Deep Bedrock Observation Wells in the Chicago Region (ft/yr)

Well & Location	1975-1980	1980-1985	1985-1991	1991-1995
COK 37N14E-27.5e (Chicago)	-4.4	+8.0	+5.5	+4.8
COK 38N13E-11.lh (Chicago)	-2.8	+3.2	+5.2	+9.5
COK 39N12E-11.7f (Maywood)	-6.2	+4.6	+2.8	+30.0
COK 41N11E-25.2h (Des Plaines)	-4.4	+0.2	+11.5	+13.2
KNE 39N8E-11.7e (Geneva)	+1.8	-25.8*	+7.7	-16.5
KNE 41N8E-12.3e (Elgin)	-5.2	0.0	+6.8	+2.2
LKE 44N12E-21.8f (Lake Bluff)	-7.7	+1.6	+6.0	+7.8
LKE 46N12E-21.1b (Zion)	-9.4	-5.6	+0.5	+7.0
WIL 33N9E-1.5e (Joliet)	+2.2	+0.4	-0.3	+0.5
WIL 35N10E-16.2h (Joliet)	-11.6	-1.2	-1.3	+1.5
WIL 36N10E-33.6h (Joliet)	-6.0	-3.8	-6.3	+8.5

Note:

* Institutional well changed to a municipal supply well

Table 4. Average Water-Level Changes in Nonpumping Deep Bedrock Wells in the Eight-County Chicago Region (ft/yr)

County	*1975-1980*	*1980-1985*	*1985-1991*	*1991-1995*
Cook	-10	-4	+12	+15
DuPage	-12	-9	+2	+38
Grundy	-5	-5	-2	+6
Kane	-7	-2	+1	+1
Kendall	-1	-3	-3	+1
Lake	-14	-1	+1	+26
McHenry	-8	-7	+1	+9
Will	-6	+2	-8	+8
Weighted average	-9	-3	+3	+14
Number of observations	349	364	320	279

During 1975-1980, average water levels declined in all eight counties. The overall weighted averages for the area were -9 ft/yr for 1975-1980. Declines during 1975-1980 ranged from 1 ft/yr in Kendall County to 14 ft/yr in Lake County. Declines exceeded 10 ft/yr in three counties.

In 1980-1985, for the first time since about the mid-1950s, average annual water levels rose in one county (1.7 ft/yr in Will County). Also for the first time, average water-level declines throughout the eight counties were less than 10 ft/yr, and the overall average decline was only 3 ft/yr.

In 1985-1991, average water levels declined in only three counties: Grundy, Kendall, and Will. The largest decline was 8 ft/yr in Will County. In contrast, average water-level rises were noted in the remaining five counties. The largest rise, 12 ft/yr, was observed in Cook County. The weighted average for the area was a rise of 3 ft/yr.

Between 1991 and 1995, for the first time ever, average water levels rose in all eight counties. The largest rise, 38 ft/yr, was observed in DuPage County, but levels also rose 26 ft/yr in Lake County and 15 ft/yr in Cook County. Overall, the weighted average for the area was a rise of 14 ft/yr. Water levels in individual wells sometimes suggested significant changes between 1991 and 1995 that were not in agreement with the regional picture. In some cases, therefore, as will be discussed in the section, "Changes in Potentiometric Surface, 1991-1995," water-level changes observed in individual wells were not necessarily reflected in the water-level change map.

Extended Chicago Area

Regional water-level trends in selected deep wells in the extended area outside the eight-county Chicago region (table 5) show less fluctuation and are less well defined. Wells in these areas are fewer and more widely spaced, and regional and local pumpage is in general considerably less.

Table 5. Average Water-Level Changes in Selected Nonpumping Deep Bedrock Wells in the Extended Chicago Region (ft/yr)

Well & Locution	*1975 1980*	*1980-1985*	*1985-1991*	*1991-1995*
BNE 44N3E-25.8b (Belvidere)	+2.8	-2.0	+0.7	+1.5
LAS 33N1E-16.8a (Peru)	-0.6	+0.2	+0.2	-0.2
LAS 33N3E- 1.6b (Ottawa)	-2.4 est-	2.4 est	+2.8	-1.0
OGL 40N1E-25.3f (Rochelle)	+2.6	+2.6	+1.5	+0.8
WIN 44N1E-23.6d (Rockford)	+0.8	+0.4	-1.2	+1.8

Also, the proximity to the primary recharge area in north-central Illinois lessens the effect of pumpage on water levels.

During the periods 1975-1980, 1980-1985, and 1985-1991, average water-level changes in five selected observation wells in the extended area ranged from rises of 2.8 ft/yr (in the early period at Belvidere in Boone County and in the late period at Ottawa in LaSalle County) to an estimated decline of 2.4 ft/yr (in the early and middle periods at Ottawa). The well at Rochelle in Ogle County exhibited modest, continuous rises during all three periods.

During the period 1991-1995, average water-level changes were small and mixed, rising between 0.8 ft/yr at Rochelle (Ogle County) and 1.8 ft/yr at Rockford (Winnebago County) and declining in LaSalle County between 0.2 ft/yr at Peru and 1.0 ft/yr at Ottawa.

Water levels in 143 wells in seven northeastern Illinois counties in the extended area were measured in both 1991 and 1995. Seventy-one wells in all seven counties indicated water-level rises. They ranged from one foot in DeKalb, Lee, Ogle, and Winnebago Counties to 156 feet in Ogle County. The large rise in Ogle County occurred at an industrial well. Rises of 50 feet or more were observed in three wells each in DeKalb and Ogle Counties. Declines were noted in 63 wells in all seven counties, ranging from one foot in DeKalb, LaSalle, and Winnebago Counties to 76 feet in LaSalle County. The large decline in LaSalle County occurred at a well in Marseilles. Declines of 50 feet or more were observed at two wells in LaSalle County and at one well in Winnebago County. Overall, the weighted average water-level change was +0.5 ft/yr and ranged from +7.5 ft/yr in Ogle County to -1.9 ft/yr in LaSalle County.

POTENTIOMETRIC SURFACE OF THE DEEP BEDROCK AQUIFERS

The potentiometric surface is an imaginary surface to which water will rise in tightly cased wells (which do not allow vertical communication between aquifers). The term "potentiometric surface" has replaced the term "piezometric surface," which was used in all but the most recent reports of this series. "Piezometric surface" was originally used to imply an artesian head at some level above the top of the aquifer. "Potentiometric surface" more appropriately refers to the water-level surface, whether or not it is above the top of the aquifer.

Previous reports have included several potentiometric surface maps of areas of the deep bedrock aquifers in northern Illinois. Maps for 1950 (Foley and Smith, 1954), 1971 (Sasman et al., 1973), and 1980 (Sasman et al., 1982) cover all of the northern part of the state. Maps for 1958 (Suter et al., 1959), 1959 (Walton et al., 1960), 1960 (Sasman et al., 1961), 1961 (Sasman et al., 1962), 1966 (Sasman et al., 1967), 1975 (Sasman et al., 1977), 1980 (Sasman et al., 1982), 1985 (Sasman et al., 1986), and 1991 (Visocky, 1993) have been limited to northeastern Illinois. The 1980 map included coverages of both the northern and northeastern portions of the state. The 1991 map is included in this report for comparison with the 1995 map.

Potentiometric Surface, 1991

Figure 7 shows the potentiometric surface of the deep bedrock aquifers in fall 1991. Water-level data used to prepare the map are included in the appendix. The general features of the 1991 potentiometric surface map differ very little from those of the potentiometric maps for 1980 and 1985.

The deepest cones of depression in the Chicago region in 1991 were in the Joliet and Elmhurst areas, where some levels were as much as 300 feet and 180 feet below msl, respectively. Significant cones of depression were present in northern Cook County (Morton Grove-Niles and Prospect Heights), Kane County (Aurora), southern Lake County (Mundelein-Vernon Hills and Lincolnshire), and McHenry County (Crystal Lake and Ringwood areas).

The zero-foot msl contour line encompassed eastern and southern DuPage County, much of western and southwestern Cook County, a portion of southern Lake County, and most of the northern half of Will County. The areal extent of this contour had diminished since 1985 to about 647 square miles. The negative 100-foot contour extended for about 151 square miles around the Ehmhurst and Joliet areas.

Other notable depressions in the potentiometric surface were identified in southwestern Will County and northeastern and southeastern Grundy County. The potentiometric surface was below the top of the Ancell aquifer in large portions of central and eastern DuPage County; in northern Will County; and in small portions of Kane, Kendall, and Grundy Counties. Together, these depressions amounted to approximately 366 square miles. An area of similar size was dewatered along the Illinois River valley in LaSalle County.

For the entire study area, the 1991 potentiometric surface map showed the areas of highest elevation in Boone/Winnebago and DeKalb/Lee/Ogle Counties. A major depression in the potentiometric surface was apparent in Winnebago County (at Rockford), and smaller depressions were seen in Boone County (Belvidere), DeKalb County (DeKalb), and LaSalle County (Ottawa and LaSalle-Peru).

The general pattern of ground-water flow in the deep bedrock aquifers was primarily from high elevations in north-central Illinois toward the east and southeast. Locally, flow traveled toward the deep cones of depression in southern Lake and northern Cook Counties, in eastern DuPage County (Elmhurst), and in Will County at Joliet. Some of the water moving toward these cones of

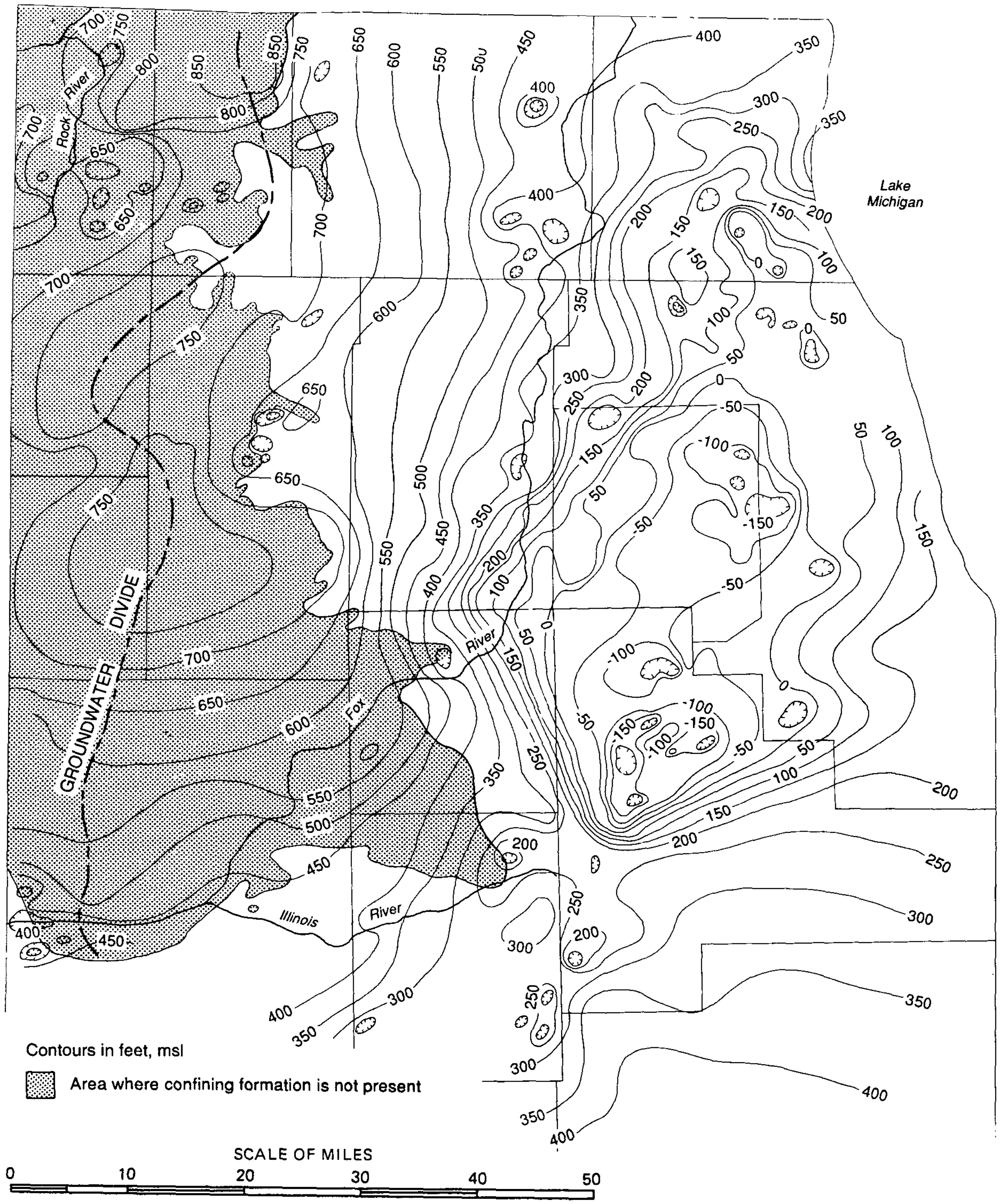

Figure 7. Potentiometric surface of the deep bedrock aquifers in northeastern Illinois, fall 1991

depression was intercepted by pumping centers at Aurora, Bloomingdale-Carol Stream, Geneva-St. Charles, Morris, Naperville, and industrial pumping centers in Grundy, southern Cook, and southern Will Counties. In addition, water from the recharge area west of the Chicago region was diverted into cones of depression at Rockford, Belvidere, DeKalb, and the Illinois River valley in LaSalle County.

Potentiometric Surface, 1995

Figure 8 shows the potentiometric surface of the deep bedrock aquifers in Fall 1995. Water-level data used to prepare the map appear in the appendix. The general features of the 1995 potentiometric surface map continue to resemble those of the maps for 1985 and 1991, despite differences in details around former pumping centers.

The deepest cones of depression in the Chicago region in 1995 were in the Joliet and Western Springs areas, where levels were as much as 246 feet and 78 feet below msl, respectively. The major cone of depression observed at Elmhurst in 1991 shrank in size and depth, but significant cones of depression were present in the Western Springs, Elk Grove, Rolling Meadows, Wheeling-Mt. Prospect, and Northbrook-Glenview areas (western and northern Cook County); Geneva-St. Charles (Kane County); Lake Zurich (southern Lake County); and Crystal Lake and Ringwood (McHenry County).

The zero-foot-msl contour line was centered around the Joliet area of northwestern Will County and southern Cook County and was present in small areas of western, central, and northern Cook County. The areal extent of this contour has diminished since 1991 to about 243 square miles. The negative 100-foot contour extended for about 77 square miles around the Joliet area, about half of its size in 1991.

Other notable depressions in the potentiometric surface were identified in northeastern and southeastern Grundy County and in southwestern Will County. The potentiometric surface appeared to remain below the top of the Ancell aquifer in the Joliet area (northern Will County) and small areas along the Illinois River (LaSalle County).

For the entire study area, the 1995 potentiometric surface map showed the areas of highest elevation once more in Boone/Winnebago and DeKalb/Lee/Ogle Counties. A major depression in the potentiometric surface remained at Rockford, and smaller or shallower depressions were again seen at Belvidere, LaSalle-Peru, and Ottawa.

The general pattern of ground-water flow in the deep bedrock aquifers continued to originate from high elevations in north-central Illinois toward the east and southeast. Locally, flow traveled toward the deep cones of depression in northern and western Cook County and Joliet. Some of the water moving toward these cones of depression was intercepted by pumping centers along the Fox River valley in Kane County, Morris, and Crystal Lake, and by industrial pumping centers in Grundy, eastern McHenry, southern Cook, and southern Will Counties. In addition, water from the recharge areas west of the Chicago region was diverted into cones of depression at Rockford, Belvidere, DeKalb, and the Illinois River valley in LaSalle County. Ground-water divides in figures 7 and 8 indicate the approximate limit of diversion for the deep bedrock aquifers west of the Chicago region.

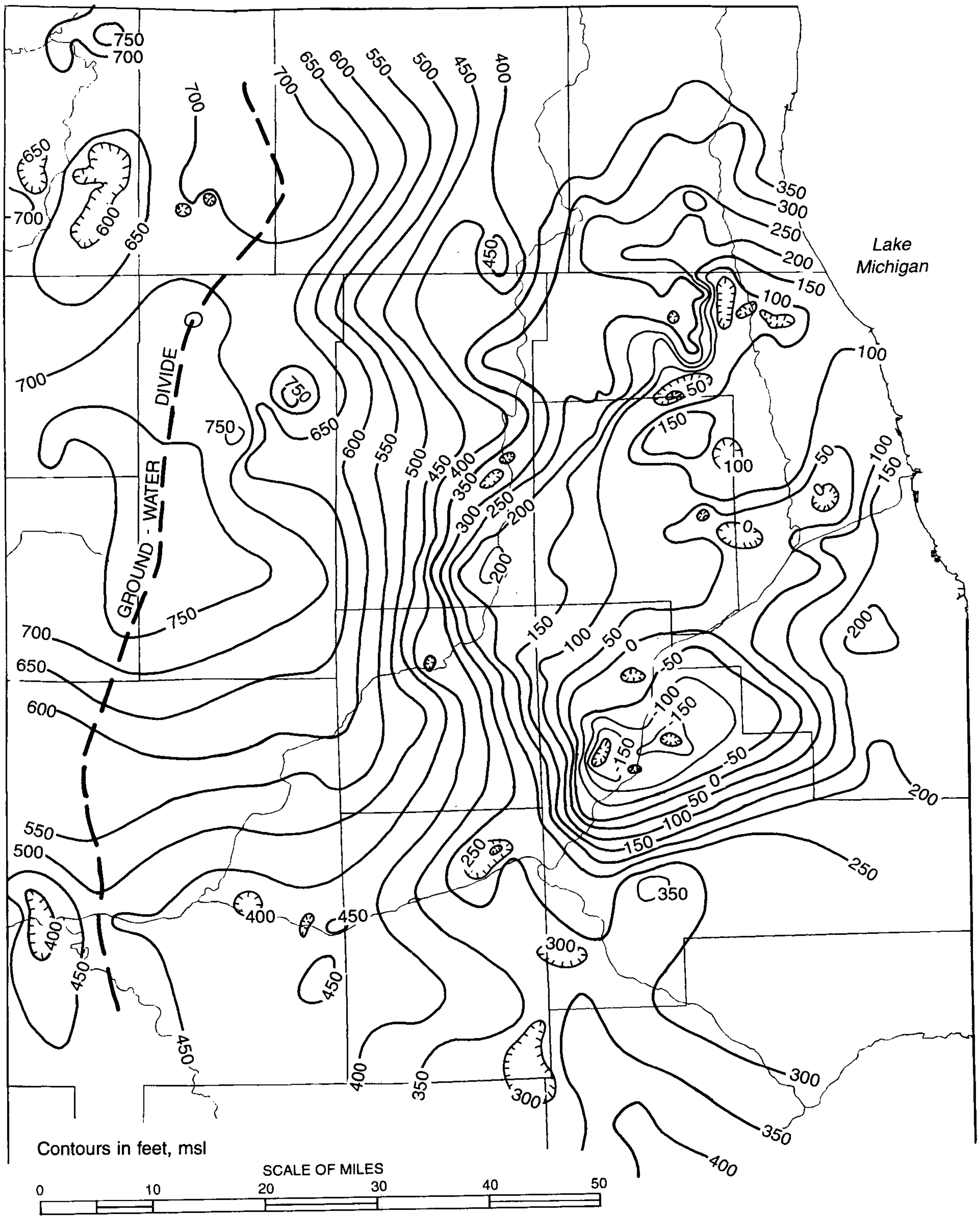

Figure 8. Potentiometric surface of the deep bedrock aquifers in northeastern Illinois, fall 1995

Changes in Potentiometric Surface, 1991-1995

Using potentiometric surface maps and the observed water-level changes in deep wells for 1991 and 1995, a map of water-level changes (figure 9) was prepared. Potentiometric surface maps were overlaid on one another, and the 1995 contours were subtracted from those on the 1991 map. Resulting data points, along with observed changes in deep wells, were used in constructing the map of water-level changes. Those changes observed in wells between 1991 and 1995 are listed in the appendix.

As was noted earlier, water-level changes in individual wells do not always correspond to or agree with regional trends observed in the majority of wells in a given region. These individual anomalies are usually not readily apparent at the time of measurement and most often are the result of effects of recent pumpage in the well or in nearby wells. In preparing a difference map, therefore, anomalous data points must be reconciled with the surrounding data, so that a set of difference contours is generated that is both consistent and reasonable.

In addition to anomalies among the *measured* data, it must be acknowledged that the precision and accuracy with which *difference* data points are generated (by subtracting one potentiometric surface map from another) are artifacts of the precision and accuracy of the potentiometric surface maps themselves. For example, slight shifts in the plotting of water-level contours on either or both maps can potentially alter the locations and values of their differences. In the same manner that anomalous measured data must be reconciled with nearby points, difference data points must also be reconciled with measured data points at nearby wells. The degree of difficulty with which this reconcilement is accomplished is a measure of the uncertainty in the resulting water-level change map.

The most obvious recovery of deep water levels occurred in southern Lake, eastern DuPage, and western Cook Counties, where water levels rose more than 200 feet. Water-level rises were widespread over an area extending from central Lake County to extreme northwestern Will County and westward to the southeastern tip of Kane County. This recovery was primarily due to the transition from the use of deep well water to the use of lake water for public supplies. The most notable switchover of such water sources occurred in spring 1992 in DuPage County shortly after the 1991 water-level measurements were concluded. Water-level rises were also found in small areas scattered over portions of western Will County and Grundy County. In the eight-county Chicago region, water-level rises of 50 feet or more occurred over an area of about 1,340 square miles or 29.9 percent of the region. Rises of 100 feet or more occurred over an area of about 610 square miles or 13.6 percent of the region.

Declines in the potentiometric surface were mostly centered on an area in southern McHenry County and northern Kane County. Additionally, scattered small areas of water-level declines were noted in portions of Will and eastern Kane Counties. In the eight-county region, declines of 50 feet or more extended over a total area of about 238 square miles or 5.3 percent of the area. Declines of 100 feet or more occurred over an area of about 114 square miles or less than 3 percent of the area.

Outside of the eight-county Chicago region, rises and declines of 50 feet or more were insignificant in occurrence, and most water-level changes were less than 50 feet,

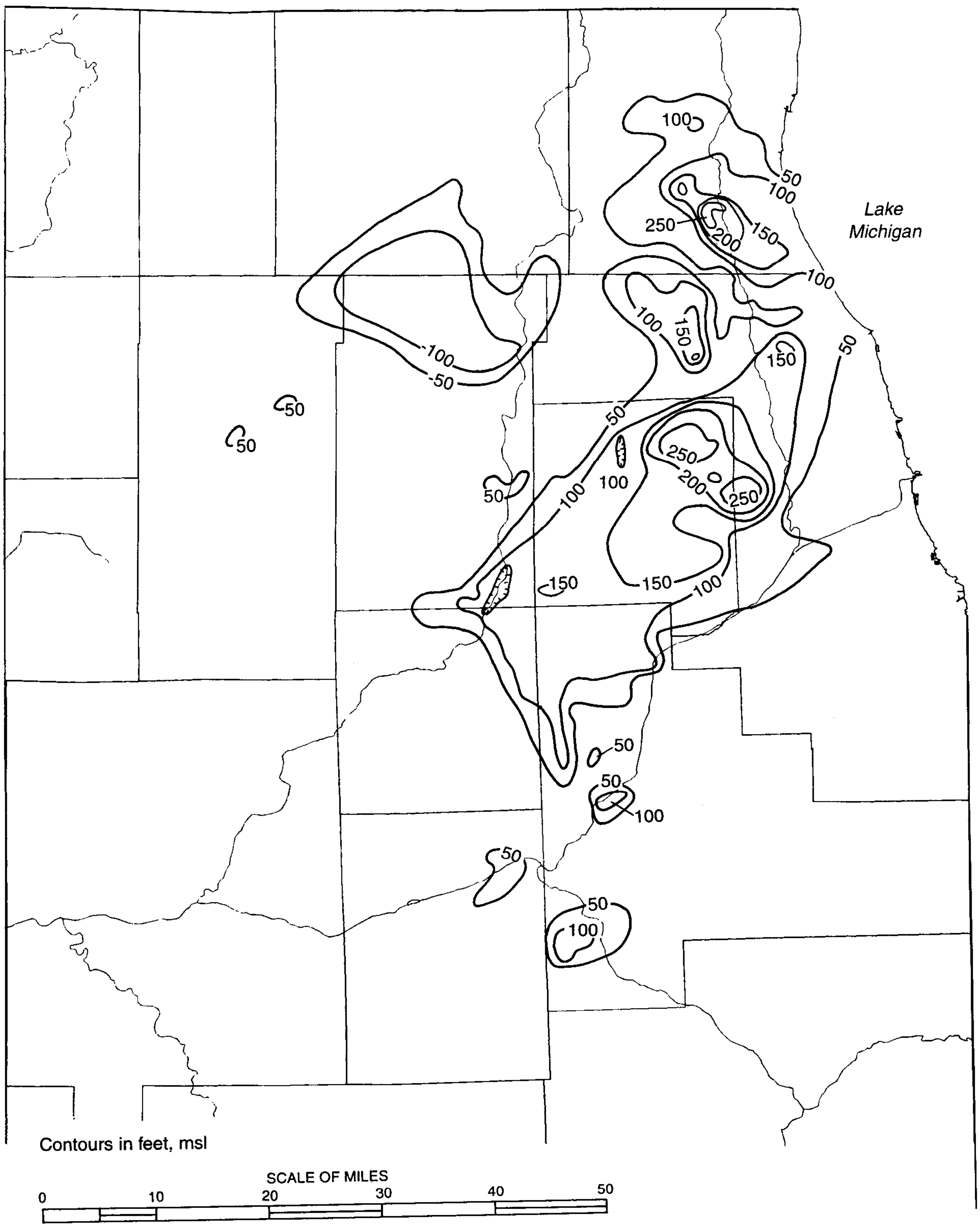

Figure 9. Changes in the potentiometric surface of the deep bedrock aquifers in northeastern Illinois, 1991-1995

REFERENCES

Burch, S.L. 1991. *The New Chicago Model: A Reassessment of the Impacts of Lake Michigan Allocations on the Deep Bedrock Aquifers in Northeastern Illinois.* Illinois State Water Survey Research Report 119,52p.

Cartwright, K. 1983. Classification of Hydrostratigraphic Units in Illinois. Illinois State Geological Survey Draft Memorandum, Open File.

Foley, F.C., and H.F. Smith. 1954. *Ground-Water Recharge of a Deeply Buried Artesian Aquifer in Illinois and Wisconsin, U.S.A.* International Association Scientific Hydrology, Assembly of Rome, Gentbrugge, Belgium, Publication 37, Book 11.

Leverett, F., 1899. *The Illinois Glacial Lobe.* U.S. Geological Survey Monograph 38,817p.

Sasman, R.T. 1965. *Ground-Water Pumpage in Northeastern Illinois through 1962.* Illinois State Water Survey Report of Investigation 50,31p.

Sasman, R.T., and W.H. Baker, Jr. 1966. *Ground- Water Pumpage in Northwestern Illinois through 1963.* Illinois State Water Survey Report of Investigation 52,33p.

Sasman, R.T., W.H. Baker, Jr., and W.P. Patzer. 1962. *Water-Level Decline and Pumpage during 1961 in Deep Wells in the Chicago Region, Illinois.* Illinois State Water Survey Circular 85, 32p.

Sasman, R.T., C.R. Benson, G.L. Dzurisin, and N.E. Risk. 1973. *Water-Level Decline and Pumpage in Deep Wells in Northern Illinois, 1966-1971.* Illinois State Water Survey Circular 113,41p.

Sasman, R.T., C.R. Benson, G.L. Dzurisin, and N.E. Risk. 1974. *Ground-Water Pumpage in Northern Illinois, 1960-1970.* Illinois State Water Survey Report of Investigation 73,45p.

Sasman, R.T., C.R. Benson, R.S. Ludwigs, and T.L. Williams. 1982. *Water-Level Trends, Pumpage, and Chemical Quality in the Cambrian and Ordovician Aquifer in Illinois, 1971-1980.* Illinois State Water Survey Circular 154,64p.

Sasman, R.T., C.R. Benson, J.S. Mende, N.F. Gangler, and V.M. Colvin. 1977. *Water-Level Decline and Pumpage in Deep Wells in the Chicago Region, 1971-1975.* Illinois State Water Survey Circular 125,35p.

Sasman, R.T., R.S. Ludwigs, C.R. Benson, and J.R. Kirk. 1986. *Water-Level Trends and Pumpage in the Cambrian and Ordovician Aquifers in the Chicago Region, 1980-1985.* Illinois State Water Survey Circular 166,47p.

Sasman, R.T., C.K. McDonald, and W.R. Randall. 1967. *Water-Level Decline and Pumpage in Deep Wells in Northeastern Illinois, 1962-1966.* Illinois State Water Survey Circular 94, 36p.

Sasman, R.T., T.A. Prickett, and R.R. Russell. 1961. *Water-Level Decline and Pumpage during 1960 in Deep Wells in the Chicago Region, Illinois.* Illinois State Water Survey Circular 83,43p.

Schicht, R.J., J.R. Adams, and J.B. Stall. 1976. *Water Resources Availability, Quality, and Cost in Northeastern Illinois.* Illinois State Water Survey Report of Investigation 83,90p.

Singh, K.P., and J.R. Adams. 1980. *Adequacy and Economics of Water Supply in Northeastern Illinois: Proposed Ground-Water and Regional Surface Water Systems, 1985-2010.* Illinois State Water Survey Report of Investigation 97,205p.

Suter, M., R.E. Bergstrom, H.F. Smith, G.H. Emrich, W.C. Walton, and T.E. Larson. 1959. *Preliminary Report on Ground Water Resources of the Chicago Region, Illinois.* Illinois State Water Survey and Geological Survey Cooperative Ground-Water Report 1,89p.

U.S. Environmental Protection Agency. 1976. "National Primary Drinking Water Regulations." *Federal Register,* July 9, 1976:28403.

U.S. Environmental Protection Agency. 1991. "National Primary Drinking Water Regulations." *Federal Register,* July 1, 1991:30274.

Visocky, A.P. 1982. *Impact of Lake Michigan Allocations on the Cambrian-Ordovician Aquifer System.* Illinois State Water Survey Contract Report 292,36p.

Visocky, A.P. 1993. *Water-Level Trends and Pumpage in the Deep Bedrock Aquifers in the Chicago Region, 1985-1991.* Illinois State Water Survey Circular 177,44p.

Visocky, A.P., M.G. Sherrill, and K. Cartwright. 1985. *Geology, Hydrology, and Water Quality of the Cambrian and Ordovician Systems in Northern Illinois.* Illinois State Geological Survey and Illinois State Water Survey Cooperative Ground-Water Report 10, 136p.

Walton, W.C. 1960. *Leaky Artesian Aquifer Conditions in Illinois.* Illinois State Water Survey Report of Investigation 39,27p.

Walton, W.C., R.T. Sasman, and R.R. Russell. 1960. *Water-Level Decline and Pumpage during 1959 in Deep Wells in the Chicago Region, Illinois.* Illinois State Water Survey Circular 79,39p.

Appendix. Water-Level Elevations of the Deep Bedrock Aquifers in Northern Illinois, 1991-1995

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Boone							
00744N03E24.8a	6	Belvidere	868	784	717	712	-5
00744N03E25.3d	1	Pillsbury-Green Giant Pckg Co.	627	770	698	716	18
00744N03E25.4d	2	Pillsbury-Green Giant Pckg Co.	550	770	704	717	13
00744N03E25.6d	2	Dean Foods Co.	868	770	680	670	-10
00744N03E25.8b	3	Belvidere	1803	765	747	753	6
00744N03E26.1e	4	Belvidere	1801	778	711	710	-1
00744N03E34.2a	8	Belvidere	1393	780	610	599	-11
00744N03E35.1f	5	Belvidere	610	800	745	736	-9
00744N03E36.2g	7	Belvidere	969	840	610	625	15
00745N03E27.4c	3	Consumers III. Wtr. Co. -Candlewick Lk.	917	885		675	
00745N04E11.7h	1	Capron	880	912	860		
00745N04E19.8f	1	McLay Grain co.	570	892	834		
Cook							
03135N14E19.4c	22	Chicago Heights	1800	677	222	239	17
03135N14E21.2h	2	Rhone Poulenc Co.	1979	640	156	168	12
03136N12E02.5h	11	Orland Park	1683	712	54	84	30
03136N12E22.6b	3	Citizens Fernway Utility (Westhaven)	1712	720	-65	-54	11
03136N13E01.2g	1	NBI Industrial Terminal	1618	597	139		
03136N13E09.8b	1	Oak Forest	1701	672	104	116	12
03137N11E14.7c	1	Powell Duffryn Terminal	1501	585	-25	20	45
03137N11E28.3b	I	DeAndreis Seminary	1690	740	-40		
03137N11E29.1g	4	Lemont	1685	737	-51	51	102
03137N11E29.4a	3	Lemont	1723	743	-69	-84	-15
03137N12E02.8h	2	Hickory Hills	1608	685	43	66	23
03137N13E26.1g	3	Oak Hill Cemetery	1637	617	235	235	0
03137N14E27.5e	1118	Met. Wtr. Recl. Dist.	1683	590	164	183	19
03137N15E08.1c	2	Falstaff Brewing Co. (2B)	1715	592	-20		
03138N12E05.8d	3	Western Springs	1600	673	-96	-19	77
03138N12E06.6b	4	Western Springs	1913	642	-66	-78	-12
03138N 12E 18.8g	3	Suburban Hospital	1540	685	6	25	19
03138N12E23.2g	13	CPC International, Inc.	1525	600	-35		
03138N12E24.7h	14	CPC International, Inc.	1481	597	-88		
03138NI2E24.8g	12	CPC International, Inc.	1507	597		31	
03138N13E08.1f	4	Rose Packing Co.	1590	594	72	108	36
03138N13E11.lb	1	Bradshaw-Praeger & Co.	1224	597	85	123	38
03138N13E19.4f	3	Viskase Corporation	1665	621	-36		
03138N13E19.6f	2	Viskase Corporation	1590	619	-41	14	55
03138N13E27.5g	1	Tootsie Roll Industries	1565	617	62	97	35
03138N14E07.6c	1	Fleischmann-Kurth Malting Co.	1583	594	102	139	37
03138N14E07.6d	2	Fleischmann-Kurth Malting Co.	1523	594	94	115	21
03139NI2E08.5g	4	Bellwood	1965	645	-110	152	262
03139N12E09.5a	3	Bellwood	1480	624	-96		
03139N12E11.7f	3	Maywood	1640	630	21	141	120
03139N12EI6.2f	5	Bellwood	1845	627	-167	101	268
03139N13E21.6g	1	Kropp Forge Co.	1636	608	-102	-45	57
03139N14E21.7b	1	Industrial Coatings Group, Inc.	1610	593	98	129	31
03139N14E21.7b	2	Industrial Coatings Group, Inc.	1603	593	197	267	70
03140N12E18.6c	1	Nelson Wire Co.	1457	663	-81		
03140N12E31.4c	2	AG Communications System 5 Inc	1468	655	-105		
03140N12E31.4d	1	AG Communications System 5 Inc	1470	655	-85	75	160
03140N12E35.2e	3	Oak Park Country Club	1497	627	30		
03141N09E23.5g	3	Streamwood	1410	820	302	310	8
03141N09E36.3f	2	Hanover Park	1429	828	173	229	56

Appendix (continued)

County location	Well no.	Owner	Depth ft.	Surface elev.	Water-level elevation 1991	Water-level elevation 1995	Water-level changes, ft. 1991-1995
Cook (cont'd)							
03141N09E36.6b	4	Hanover Park	1434	820		291	
03141N10E06.5b	10	Hoffman Estates	1357	810	228	250	22
03141N10EI2.3g	21	Schaumburg	1355	735	60	130	70
03141N10E21.1f	20	Schaumburg	1440	800		190	
03141N10E31.3e	3	Hanover Park	1952	798	201	263	62
03141N10E34.8h	15	Schaumburg	1350	810	165	190	25
03141N10E36.8b	11	Elk Grove Village	1367	725	34	48	14
03141N11E08.3a	6	Rolling Meadows	1602	694	82	245	163
03141N11E09.7g	1	U.S. Army	1812	713	115		
03141N11E14.5b	3	Citizens Waycinden Division	1382	672	32	32	0
03141N11E16.2h	12	Arlington Heights	1780	714		304	
03141N11E23.7f	16	Mt. Prospect	1961	675	37	85	48
03141N11E24.1f	2	Citizens Waycinden Division	1652	660	10	74	64
03141N11E25.2h	7	Des Plaines	1815	655	186	239	53
03141N11E25.6b	4	Touhy Mobile Homes	1515	657	-118	7	125
03141N11E25.6b	5	Touhy Mobile Homes	940	657	65		
03141N11E27.3f	9	Elk Grove Village	1403	681	-34	26	60
03141N11E31.3a	14	Elk Grove Village	1390	702	-16	-108	-92
03141N12E12.8b	1	North Suburban Public Util.	1414	662	-66	99	165
03141N12E26.6e	1	Park Ridge Country Club	1355	643	10		
03141N13E20.7e	1	The Heam Co.	1414	627	27		
03141N13E22.4g	2	Evanston Country Club	1465	608	34	76	42
03141N13E29.8d	1	Howard Commons	1465	624	34		
03142N09E25.5g	4	Willow Creek Church	947	840		251	
03142N09E32.6e	1	Sears Roebuck & Co.	1380	845		225	
03142N09E34.7a	1	Allstate Insurance Co.	1250	850	255	264	9
03142N09E34.8a	3	Allstate Insurance Co.	1370	850	310	298	-12
03142N10E01.8f	15	Palatine	1603	750	174	225	51
03142N10E14.6h	10	Palatine	1995	750	198	247	49
03142N10EI5.3f	7	Palatine	1350	750	40	290	250
03142N10E24.8a	1	Arlington Park Jockey Club	1825	724	144	149	5
03142N10E25.8g	4	Arlington Park Jockey Club	1906	728	33	52	19
03142N10E26.4h	5	Rolling Meadows	1555	733	140	293	153
03142N10E29.7e	9	Hoffman Estates	1392	820	172		
03142N11E03.3b	5	Wheeling	1355	650		32	
03142N11E05.8e	1	Buffalo Grove	1335	725	100	149	49
03142N11E06.6c	13	Arlington Heights	1795	730	140	300	160
03142N11E08.1a	11	Arlington Heights	1647	689	144	287	143
03142N11E10.7a	7	Wheeling	1350	661	71	-6	-77
03142N11E12.7b	1	Plum Creek Condominiums	1338	640	38		
03142N11E12.8b	2	Plum Creek Condominiums	1323	645		95	
03142N11E17.7e	9	Arlington Heights	1532	691		221	
03142N11E24.4d	4	Citizens Chicago Suburban Division	1323	642	-23	0	23
03142N11E26.4h	2	Prospect Heights	1318	648	-2	58	60
03142N11E26.7d	2	Citizens Chicago Suburban Division	1468	661	36	73	37
03142N11E27.5h	17	Mt. Prospect	1282	663	11	13	2
03142N11E30.3b	17	Arlington Heights	1323	708	53	308	255
03142N11E31.7a	16	Arlington Heights	1810	698	103	270	167
03142N11E33.3b	4	Mt. Prospect	1950	693	63	123	60
03142N11E34.4g	5	Mt. Prospect	1822	670	15	80	65
03142N12E14.2a	3	Sunset Ridge Country Club	1396	655	21	106	85
03142N12E14.2c	2	Sunset Ridge Country Club	1247	655	53		
03142N12E18.1e	1	Mission Brook San. Dist.	1399	685	35	110	75
03142N12E18.2b	1	Illinois Bell Telephone Co.	1380	660	6	79	73
03142N12E18.3a	1	Culligan U.S.A.	1380	652	-63	79	142
03142N12E18.3e	3	Mission Hills Country Club (1)	1400	660	25	75	50

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Cook (cont'd)							
03142N12E18.4a	1	Donlen Corp.	1330	660	56		
03142N12E19.1b	3	Allstate Insurance Co.	1401	662	-6	67	73
03142N12EI9.1c	1	Allstate Insurance Co.	1400	663	-3	32	35
03142N12E19.1d	2	Allstate Insurance Co.	1404	663	25	43	18
03142N12E19.2a	4	Allstate Insurance Co. (G)	1400	655	6	63	57
03142N12EI9.2e	2	Andersen Consultants	1400	657	23	130	107
03142N12E19.2h	2	Culligan U.S.A.	1380	655	-100	84	184
03142N12E19.3a	1	Allstate Ins. Co. - West Plaza	1352	640	-1	94	95
03142N12E19.3f	1	Andersen Consultants	1400	655	-10	75	85
03142N12E19.4b	2	Allstate Ins. Co. - West Plaza	1328	650	30	78	48
03142N12E19.4e	1	Household Finance Corp.	1308	648	83		
03142N12E23.6b	1	Sunset Mobil Home Park	1415	626	39	54	15
03142N12E28.7e	1	Signode Steel Strapping Co.	1452	670	-35	22	57
03142N12E29.1h	1	Glenbrook Hospital	1406	677	22		
03142N12E32.4f	1	Life Source	1465	670	15		
03142N12E32.6f	2	Zenith Radio Corp.	1400	662	127	108	-19
03142N12E36.7e	2	North Shore Country Club	2017	645	48		
03142N12E36.8f	3	North Shore Country Club	1444	640		106	
03142N13E32.1a	2	Westmoreland Country Club	1477	630		125	
DeKalb							
03737N05E32.1c	1	Somonauk	190	685	656	657	1
03737N05E32.1c	2	Somonauk	502	685	656	648	-8
03737N05E36.7g	3	Sandwich	610	655	639	633	-6
03737N05E36.7h	1	Sandwich	600	667	647	649	2
03737N05E36.7h	2	Sandwich	600	667	635		
03738N04E15.8d	3	Waterman	400	813	771	771	0
03738N04E16.2d	2	Waterman	400	825	770	789	19
03738N05E14.4d	3	Hinckley	605	740	708	719	11
03738N05E15.2d	2	Hinckley	708	740	718	723	5
03740N03E15.7c	2	Kishwaukee College	920	910	705	716	11
03740N03E23.6e	2	Malta	1254	915	735	739	4
03740N03E23.7e	1	Malta	853	915	770	769	-1
03740N04E01.4e	7	Sycamore	1233	835	525	559	34
03740N04E10.7b	14	DeKalb	1313	890	604		
03740N04E15.7a	6	DeKalb	1291	855	594		
03740N04E16.1g	1	DeKalb Univ. Development Corp.	805	880	730	791	61
03740N04E16.2g	2	DeKalb Univ. Development Corp.	970	883	720		
03740N04E21.4f	10	DeKalb	1310	880	623		
03740N04E23.5d	4	DeKalb	1325	885	592		
03740N04E26.3g	1	Del Monte Corp.	1324	890	600	622	22
03740N04E26.3g	2	Del Monte Corp.	1345	890	635		
03740N04E26.6e	7	DeKalb	1328	885	561		
03740N04E33.1h	12	DeKalb	1200	862	584		
03740N04E34.5c	13	DeKalb	1222	865	641		
03740N05E05.5e	5	Sycamore	1270	872		683	
03740N05E06.7a	8	Sycamore	1300	880	641	657	16
03740N05E29.3g	3	Cortland	1307	892		622	
03741N05E32.1g	3	Sycamore	1002	845	737	815	78
03741N05E32.3e	1	Sycamore	902	870	815	820	5
03741N05E32.7g	6	Sycamore	1214	845	615	665	50
03742N03E26.3h	0	Kirkland	737	767	761	763	2
03742N03E26.3h	1	Kirkland	636	764	752	756	4
03742N04E22.7a	2	Kingston	755	830	703	675	-28
03742N04E22.7a	3	Kingston	717	830	690		

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
DeKalb(cont'd)							
03742N05E19.4b	3	Genoa	732	830	710	699	-11
03742N05E20.7a	4	Genoa	770	847	642	645	3
DuPage							
04337N11E02.7d	4	Southeast Region Water Facilty	1610	710	-10		
04338N09E01.5a	28	Naperville	1490	730	-40	105	145
04338N09E22.2h	26	Naperville	1500	700	-17	118	135
04338N09E29.5f	22	Aurora	1420	684	-6	170	176
04338N10E08.5h	24	Naperville	1560	772		97	
04338N10E18.3d	25	Naperville	1491	695	-63	113	176
04338NIOE30.4d	16	Naperville	1478	690	-25	110	135
04338N10E33.4h	20	Naperville	1572	748		76	
04338N11E03.7e	13	Westmont	1578	740	-96	50	146
04338N11E10.7e	11	Westmont	1604	751	-58	64	122
04338N11E11.5c	7	Clarendon Hills	1585	722	-143	60	203
04338N11E23.5e	3	Willowbrook	1620	734	-58	50	108
04338N11E28.1c	4	Darien	1612	767	-43	69	112
04339N09E04.1b	3	West Chicago	1378	762	123	146	23
04339N09E05.4d	5	West Chicago	1376	751	136	210	74
04339N09E08.4b	9	West Chicago	1424	751		117	
04339N09E15.7h	4	West Chicago	1465	746	48	155	107
04339N09E19.6c	4	Fermi Nat. Accelerator Lab.	1432	756	131	439	308
04339N10E01.5e	1	Comm. Ed. - Lombard Station	1565	740	-47		
04339N11E04.1e	7	Villa Park	1420	702	-143	107	250
04339N11E06.3a	4	Lombard	2062	698	-67		
04339N11E09.2h	2	Villa Park	1605	699	-95	138	233
04339N11E10.lh	4	Elmhurst	1400	669	-176	119	295
04339N11E10.3g	11	Ovaltine Food Products	1897	670	73	222	149
04339N11E13.3g	10	Elmhurst	1567	705	-150		
04339N11E15.8d	10	Villa Park	1458	685	-79	103	182
04339N11E17.8d	7	Lombard	1520	730	-100	72	172
04339N11E20.7a	8	Lombard	1590	775	-114	106	220
04339N11E24.3b	5	Oak Brook	1503	680	-170	80	250
04339N11E26.5h	2	Oak Brook (Well #l)	1521	685	-123	75	198
04339N11E26.8h	1	Oak Brook (Well #2)	1458	690	-141	45	186
04339N11E27.6g	7	Oak Brook	1513	715	-135	-30	105
04339N11E33.6h	6	Oak Brook	1522	695	-122	24	146
04340N09E03.5b	7	Bartlett	1996	812		229	
04340N09E11.6h	4	Bartlett	1985	770	10	5	-5
04340N09E13.8d	8	Bartlett	1445	793	136	233	97
04340N10E09.3h	5	Roselle	1423	805	63	67	4
04340N10E14.8c	2	Bloomingdale	1395	750	-27	109	136
04340N10E20.4g	8	Bloomingdale	1415	765	-17	42	59
04340N10E32.1c	4	Carol Stream	1963	790	25	70	45
04340N11E10.4h	5	Wood Dale	1400	695	-80	105	185
04340N11E11.4d	7	Bensenville	1900	680		145	
04340N11E13.4b	6	Soo Line Railroad	1440	671	93	198	105
04340N11E14.4e	3	Bensenville	1445	670		130	
04340N11E16.6g	7	Wood Dale	1356	693	42	315	273
04340N11E26.2h	6	Bensenville	1900	684		89	
04340N11E31.5a	5	Lombard	1793	738	-92		
04340N11E35.5e	6	Elmhurst	1476	703	-135	83	218
Grundy							
06331N06E06.2e	2	Kinsman	785	658	418	416	-2
06331N08E04.1a	4	Gardner	1933	588	381	360	-21

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Grundy (cont'd)							
06331N08E04.2a	5	Gardner	1929	587		397	
06331N08E04.2b	3	Gardner	972	586		373	
06331N08E11.6a	4	South Wilmington	970	585		279	
06331N08E11.6b	3	South Wilmington	994	586		281	
06332N08E03.1e	4	Coal City	793	567	295	301	6
06332N08E26.1f	1	Braceville	868	580		301	
06333N06E29.3d	2	Explosives Technologies Intl.	1433	502	417	418	1
06333N06E29.4e	6	Explosives Technologies Intl.	1530	610	399		
06333N07E04.2a	3	Morris	1485	523	283	323	40
06333N07E04.4c	5	Morris	1462	506	300	306	6
06333N07E04.6c	6	Morris	1450	525		339	
06333N07E09.3h	4	Morris	1501	519	277	291	14
06333N08E07.4c	3	Comm. Ed. - Collins Station	1513	525	247	289	42
06333N08E07.5f	1	Comm. Ed. - Collins Station	1510	515	220		
06333N08E07.8d	4	Comm. Ed. - Collins Station	1495	520	231		
06333N08E34.1d	5	Coal City	1785	560	317	316	-1
06333N08E35.3f	1	Coal City	805	560		330	
06333N08E36.5a	1	Diamond	723	562	459		
06334N08E01.3e	3	Minooka	1508	610	240	251	1 l
06334N08E01.3e	4	Minooka	725	610	311	340	29
06334N08E20.2e	1	Quantum Chemical	1453	524		127	
06334N08E21.3f	2	Alumax Mill Products, Inc.	1515	525	223	277	54
06334N08E21.3g	1	Alumax Mill Products, Inc.	1540	525	213	268	55
06334N08E21.4f	3	Alumax Mill Products, Inc.	1540	528	183		
06334N08E21.9a	3	Quantum Chemical	1463	523	101		
06334N08E21.9c	2	Quantum Chemical	1470	526	110	99	-11
06334N08E22.6e	2	Northern Ill. Gas Co. SNG Plant	1519	523	223	225	2
06334N08E22.8e	1	Northern Ill. Gas Co. SNG Plant	1511	522	202	209	7
06334N08E28.5f	5	Quantum Chemical	1455	502	181		
06334N08E34.7h	1	Reichhold Chemicals, Inc.	706	510	246	410	164
06334N08E34.7h	2	Reichhold Chemicals, Inc.	710	518	306	418	112
06334N08E35.1e	2	Comm. Ed. - Dresden Station	1500	515	286	257	-29
06334N08E35.1g	1	Comm. Ed. - Dresden Station	1499	519	241	241	0
06334N08E35.4d	2	General Electric Co.	788	533	303	313	10
Kane							
08938N07E05.2d	1	Waubonsee College	1323	703	466	455	-11
08938N07E19.7e	4	Sugar Grove	1475	705	429	499	70
08938N07E24.6h	21	Aurora	1447	670	224		
08938N07E25.5b	23	Aurora	1420	670	144	223	79
08938N08E01.2c	20	Aurora	1400	715	46	171	125
08938N08E03.6g	5	North Aurora	1330	700	142	166	24
08938N08E04.3g	3	North Aurora	1305	675	148	190	42
08938N08E04.8d	4	North Aurora	1325	689	145	140	-5
08938N08E08.3a	25	Aurora	1460	695	130	195	65
08938N08E13.8b	1	Davey Co.	1397	696	49	176	127
08938N08E15.6f	1	Oberweiss Dairy	875	660	69	155	86
08938N08E16.4d	17	Aurora	2152	685	305	275	-30
08938N08E19.5a	19	Aurora	1424	685	118	168	50
08938N08E24.7c	18	Aurora	1486	715	46	172	126
08938N08E29.2h	15	Aurora	1719	665	76	191	115
08938N08E32.4f	4	Montgomery	1333	641	41		
08938N08E33.7c	3	Montgomery	1336	635	57	125	68
08938N08E34.6b	8	Montgomery	1378	665	21	151	130
08938N08E34.8g	16	Aurora	2139	660	116	178	62
08939N07E05.7f	4	Elburn	1353	840		480	

Appendix (continued)

County Location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Kane (cont'd)							
08939N07E05.8f	1	Elburn	1350	850	494	494	0
08939N07E10.4f	1	Broadview Academy	1335	790	380		
08939N08E02.4c	5	Geneva	2292	753	359	299	-60
08939N08E03.5e	1	Burgess Norton Mfg. Co.	1308	760	346	355	9
08939N08E03.8g	3	Geneva	2300	759	273	269	-4
08939N08E09.8h	6	Geneva	1350	758	357	215	-142
08939N08E11.7e	7	Geneva	2001	730	315	249	-66
08939N08E22.3e	2	Batavia	2200	667	169	234	65
08939N08E22.3e	3	Batavia	2200	667	388	406	18
08939N08E23.8f	4	Batavia	1357	721	190	233	43
08939N08E26.6g	5	Batavia	1440	780	186	186	0
08939N08E33.5g	2	Mooseheart Home	1508	704	181	208	27
08939N08E33.5g	3	Mooseheart Home	1386	713	208	243	35
08940N06E30.5a	4	Maple Park	960	862	601	606	5
08940N07E24.5d	1	Wasco Sanitary Dist. Water System	875	800		459	
08940N07E32.8b	3	Elburn	1393	900	486	502	16
08940N08E09.1h	2	Silver Glen Estates	700	735		423	
08940N08E24.6g	1	Royal Fox Golf Course	1345	760	340	332	-8
08940N08E25.4a	8	St. Charles	1368	761	340	340	0
08940N08E27.5a	3	St. Charles	1191	690	271	281	10
08940N08E27.6b	4	St. Charles	1647	692	279	291	12
08940N08E31.6f	5	Illinois Youth Center	1292	763		374	
08940N08E31.6h	4	Illinois Youth Center	1322	790	364	384	20
08940N08E34.6e	5	St. Charles	1713	764	333	309	-24
08941N06E09.1g	2	Burlington	1105	922		570	
08941N06E09.1g	3	Burlington	1105	925	576	580	4
08941N08E11.1h	2	Elgin (Slade Ave. #2)	1965	723	365	240	-125
08941N08E11.1h	3	Elgin (Slade Ave. #3)	1960	725	345	303	-42
08941N08E11.lh	4	Elgin (Slade Ave. #4)	1880	720	340		
08941N08E11.2g	1	Elgin (Slade Ave. #1)	2000	721		264	
08941N08E11.2g	5	Elgin (Slade Ave. #5)	1225	720	350	246	-104
08941N08E11.3f	6	Elgin (Slade Ave. #6)	1300	720	350	206	-144
08941N08E12.3e	1	Simpson Co.	998	805	357	366	9
08941N08E16.2d	704	Elgin (4A)	1345	831	357		
08941N08E16.4c	701	Elgin (1A)	1305	858	398	252	-146
08941N08E16.4d	702	Elgin (2A)	1353	861	377	308	-69
08941N08E16.4d	703	Elgin (3A)	1320	866		286	
08941N08E16.7c	705	Elgin (5A)	1310	815	400	273	-127
08942N06E03.1e	7	I11 Toll Highway Comm. (M6)	962	910	618		
08942N06E21.2b	5	Hampshire	818	878	565	452	-113
Kankakee							
09129N10E04.2a	1	Nat. Gas Ppl. (Holtman #1)	1837	690	416	418	2
09130N09E03.8g	1	Nat. Gas Ppl. (P. Cook #G-l)	1815	613	396	394	-2
09130N09E06.8a	1	Reddick	1188	612	289	252	-37
09130N10E08.5a	1	Nat. Gas Ppl. (Heimburger #1)	2582	628		380	
09130N10E16.8c	1	Nat. Gas Ppl. (J. Karcher #1)	1825	635	400	403	3
09130N 10E29.2h	5	Herscher	789	648	413	413	0
09130N10E30.1h	1	Nat. Gas Ppl. (Saffer #1)	1788	649	409	418	9
09130N10E34.8f	1	Nat. Gas Ppl. (G. Clodi #1)	1881	670	408	412	4
Kendall							
09335N06E05.6a	3	Newark	336	690	607	608	1
09335N06E06.2e	2	Newark	287	663	583	571	-12
09336N07E06.1g	1	Fox Lawn Subdivision	715	665	476	479	3
09336N07E16.5g	1	I11. Division of Highways	750	725	482	489	7

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth Ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Kendall (cont'd)							
09337N06E22.7b	1	Sparkling Spring Water Co.	550	650		581	
09337N07E27.2b	1	Hide-A-Way Lakes Inc.	550	590	386	396	10
09337N07E28.8b	4	Yorkville	1393	628	313	338	25
09337N07E31.5b	1	Hoover Outdoor Ed. Center	850	640		465	
09337N07E32.1e	3	Yorkville	1335	584	330	334	4
09337N08E05.5i	1	AT&T	1332	640		252	
09337N08E05.6e	2	Aurora Sanitary District	1325	628	104	184	80
09337N08E05.9f	1	Caterpillar Tractor Co.	1384	661	97		
09337N08E06.2d	3	Caterpillar Tractor Co.	1352	662	123		
09337N08E06.2f	2	Caterpillar Tractor Co.	1346	660	110		
09337N08E07.2b	6	Oswego	1392	652		202	
09337N08E27.2e	4	Oswego	1396	658		210	
09337N08E20.8h	3	Oswego	1378	640	185	219	34
Lake							
09743N09E11.2a	2	Lake Barrington Shores	1305	815	200	210	10
09743N10E06.5b	1	Wynstone Water Co.	1001	850		244	
09743N20E06.5b	3	Wynstone Water Co.	1000	850		341	
09743N20E06.5c	2	Wynstone Water Co.	1000	860		317	
097043N10E06.7b	4	Wynstone Water Co.	1321	830		235	
09743N10E07.1a	11	Lake Zurich	1358	838		235	
09743N10E13.2g	3	Fields of Long Grove	980	741		183	
09743N10E24.7d	1	Kemper Insurance	1400	796	147	293	146
09743N10E15.2d	2	Kemper Insurance	1402	796	125	160	35
09743N10E16.4d	8	Lake Zurich	1373	868	159	216	57
09743N10E19.4h	10	Lake Zurich	1340	850	170	212	42
09743N10E21.5e	7	Lake Zurich	1333	846		201	
09743N20E23.2b	2	Glenstone Subdivision	980	750		188	
09743N20E29.2h	9	Lake Zurich	1365	875	146	183	37
09743N11E09.4a	8	Vernon Hills (Well 3)	1265	700	-81	220	301
09743N11E28.4d	1	Kemper Sports Management	982	740		169	
09743N11El8.5a	3	Royal Melbourne Homeowner Assn.	925	725		165	
09743N11E18.6a	2	Royal Melbourne Homeowner Assn.	958	725		172	
09743N11El8.7a	1	Royal Melbourne Homeowner Assn.	945	725		181	
09743N11E19.1d	1	Briarcrest Subd. Homeowners Assn.	960	690		196	
09743N11E19.1d	3	Briarcrest Subd. Homeowners Assn.	940	695		190	
09743N11E21.3g	1	Powernail Co.	1258	685	220		
09743N11E22.6d	3	Lincolnshire	1300	667	-3	196	199
09743N11E32.8f	2	Buffalo Grove	1355	703	118	173	55
09743N11E34.2g	6	Pekara Subdivision	980	642		107	
09743N12E30.4f	1	Deerfield Park District	1375	660		157	
09743N12E31.6e	1	Baxter Healthcare Corp.	1456	685	-56	153	209
09743N22E33.6f	1	Kitchens of Sara Lee, Inc.	1350	690	2		
09744N09E24.5d	4	Wauconda	1264	792	303	348	45
09744N10E12.8a	9	Mundelein	1380	830	260	265	5
09744N10E25.1c	10	Mundelein	1421	760	-75	245	320
09744N11E10.3b	3	Countryside Manor	1040	672	167	262	95
09744N11E21.7f	11	Libertyville	1490	703	218	278	160
09744N11E28.4e	12	Libertyville	1926	700	175	275	200
09744N11E31.4h	8	Mundelein	1383	730	65		
09744N11E32.6a	6	Vernon Hills	1912	725	120	425	305
09744N11E33.3g	1	Cuneo Museum Gardens	1290	690	134	262	128
09744N11E33.5a	7	Vernon Hills	1870	685	-25	220	245
09744N12E21.8f	4	Lake Bluff#2	1804	680	346	377	31
09745N10E15.7e	6	Round Lake Beach	1287	790	350	405	55
09745N10E20.4h	7	Round Lake Beach	1250	760	264	380	126

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Lake (cont'd)							
09745N10E26.2b	4	Grayslake	1354	780	240	315	75
09745N10E30.3d	3	Round Lake	1241	791	313	365	52
09745N11E07.1b	7	Grandwood Park	1020	772		297	
09745N11E14.5a	1	Gurnee	1517	667	282	360	78
09745N11E30.1a	2	Wildwood	1845	785	215	335	120
09745N11E30.4g	4	Wildwood	1320	795	235	326	91
09745N11E31.5g	7	Wildwood	1320	813	223	321	98
09745N11E32.3f	1	Merit Club	1367	755		313	
09745N11E36.7c	3	Baxter Healthcare Corp.	1415	710	229	305	76
09745N11E36.7d	1	Baxter Healthcare Corp.	1421	710	293	273	-20
09746N12E14.6g	1	U.S. Geological Survey	1203	585	351	372	21
09746N12E21.1b	1	Zion	1100	633	336	364	28
LaSalle							
09931N01E24.6e	4	Lostant	1881	700	442	455	13
09931N03E22.8h	1	Kangley	542	632	446	451	5
09932N01E04.7b	1	Cedar Point	1750	653	350		
09932N02E05.4h	2	Matthiesen State Park	304	640	560	485	-75
09932N05E17.1a	2	Comm. Ed. - Lasalle Station	1620	711	479	479	0
09932N05E17.2f	1	Comm. Ed. - Lasalle Station	1629	712	438	430	-8
09933N01E08.2f	8	Peru	2764	638	390	385	-5
09933N01E16.8a	4	Peru	1506	460	459	458	-1
09933N01E16.8a	6	Peru	2665	540	382	299	-83
09933N01E20.1h	7	Peru	2591	460	385	367	-18
09933N01E20.2h	5	Peru	2601	465	389	381	-8
09933N01E20.8h	1	American Nickeloid Co.	1632	595	462	464	2
09933N01E36.6g	3	Oglesby	2821	630	400	413	13
09933N01E36.6g	4	Oglesby	2795	630	390	429	39
09933N02E09.7b	2	North Utica	1078	470	500	496	-4
09933N02E09.8b	1	North Utica	618	480	510	494	-16
09933N02E21.2g	3	Starved Rock State Park	401	470	480	454	-26
09933N02E21.3g	2	Starved Rock State Park	475	470	466	446	-20
09933N03E01.6b	7	Ottawa	1187	489	436	432	-4
09933N03E01.7c	11	Ottawa	1203	488		428	
09933N03E01.8a	8	Ottawa	1180	489	429		
09933N03E03.2b	1	Lavico Polymers (USA), Inc.	1225	490	457	457	0
09933N03E03.5a	2	Lavico Polymers (USA), Inc.	1255	490	430	442	12
09933N03E12.2h	12	Ottawa	1200	492	434	429	-5
09933N03E16.2b	5	Libbey-Owens-Ford Glass Co.	1255	470	333		
09933N03E16.2f	1	Naplate	420	485	437	423	-14
09933N03E17.7c	1	Buffalo Rock State Park	480	542	457	454	-3
09933N04E13.2f	5	Marseilles	1450	670	493	417	-76
09933N04E13.3c	3	Marseilles	850	498	433	455	22
09933N04E15.7e	2	General Electric Plastic Plant	1292	480	352	309	-43
09933N04E15.7f	1	General Electric Plastic Plant	1253	480	400		
09933N04E15.7h	4	General Electric Plastic Plant	444	485		356	
09933N04E15.8f	3	General Electric Plastic Plant	1243	490	387	362	-25
09933N04E16.3g	1	Ottawa Steel & Wire	442	480	401	386	-15
09933N04E16.6g	1	Garvey International	440	480	414	400	-14
09933N05E07.6a	4	Marseilles	1466	688	406	405	-1
09933N05E20.4e	1	Vigoro Industries, Inc.	360	496	441	441	0
09933N05E21.5c	1	PCS Phosphate	410	490	420	389	-31
09933N05E23.1g	3	Seneca	1445	635		425	
09933N05E24.8c	1	Seneca	700	510	418	465	47
09934N01E05.1h	15	Northern Ill. Gas Co. (Weldon 15)	1007	678	584	581	-3
09934N01E05.2h	9	Northern Ill. Gas Co. (Weldon 9)	1022	681	581	578	-3

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
LaSalle (cont'd)							
09934N03E35.4a	2	Oak Lane Subdivision	504	610		450	
09934N03E35.7a	1	Land & Water Association	540	612	472		
09934N04E09.4d	1	Wedron Silica Co. (Plant 1)	242	500	340		
09934N04E09.4g	1	Wedron Silica Co. (Housing 1)	261	545	470	500	30
09934N04E25.2b	1	Illinois Prairie Estates	681	760	476	488	12
09934N05E02.2h	3	AT&T	377	770	543	569	26
09934N05E02.2i	1	AT&T	1348	770	510	483	-27
09934N05E02.3h	2	AT&T	1353	770	502	480	-22
09935N01E34.8g	1	Northern Ill. Gas Co. (A. Engel #1)	1292	675	592	587	-5
09935N05E08.6b	1	Sheridan Correctional Ctr.	885	591	571	573	2
09935N05E17.7h	3	Sheridan Correctional Ctr.	900	592	562	566	4
09935N05E20.1b	1	Girl Scouts - Camp Merrybrook	300	610	565	521	-44
09936N01E27.4a	1	Del Monte Corp.	1384	730	605	560	-45
09936N01E27.5b	2	Del Monte Corp.	1385	740	570	569	-1
09936N01E29.2d	6	Mendota	1408	771	561	551	-10
09936N01E32.1a	4	Mendota	1360	740	572	570	-2
09936N01E33.3g	3	Mendota	1377	740	574	577	3
09936N01E36.6h	7	Mendota	508	715		689	
09936N01E36.6h	8	Mendota	519	715		694	
09936N03E18.4d	2	Earlville	150	700	640		
09936N03E18.4d	3	Earlville	625	703	659	663	4
09936N05E08.4g	3	Lake Holiday Utilities	664	670	638	630	-8
09936N05E08.5g	1	Lake Holiday Utilities	663	670	620	626	6
Lee							
10319N11E09.1a	1	Sublette	752	920	685		
10319N11E09.1a	2	Sublette	771	920	672	674	2
10322N11E27.5c	1	Ashton	545	810	675		
10322N11E27.6f	3	Ashton	1212	862	672		
10337N01E08.7d	4	West Brooklyn	676	945	704	705	1
10337N01E08.8c	5	West Brooklyn	680	945	665	687	22
10337N02E10.2b	1	Paw Paw	1018	928	726	729	3
10337N02E10.2c	2	Paw Paw	1053	945	751	763	12
10338N02E33.4e	1	Ill. Dept. of Transportation	1014	880		716	
10338N02E33.5e	2	Ill. Dept. of Transportation	973	880		728	
McHenry							
11143N07E22.2f	11	Lake in the Hills	1256	875		364	
11143N08E06.3a	6	Crystal Lake	1295	892	310	429	119
11143N08E08.2c	8	Crystal Lake	1300	900	406	422	16
11143N08E12.2d	4	Cary	1350	855	350	354	4
11143N08E14.1e	6	Cary	1300	840	332	354	22
11143N08E20.4c	5	Lake in the Hills	910	870	471	494	23
11143N08E21.3a	1	Material Service Corp.	1262	835	433		
11143N08E32.4c	1	The Golf Club of Illinois	1295	910	423	435	12
11143N08E33.4h	4	Algonquin	955	870	491	501	10
11144N05E35.5h	1	Arnold Engineering Co.	846	818	661	738	77
11144N08E33.5a	7	Crystal Lake	1400	930	365	377	12
11144N09E20.7d	8	Island Lake	950	740		365	
11145N08E10.7a	9	Morton International	1161	843		445	
11145N08E10.7c	8	Morton International	1160	835	368		
11145N08E10.8a	2	Modine Mfg. Co.(owner #1)	1200	843	344	365	21
11145N08E10.8d	7	Morton International	1161	850	390		
11145N08E15.8h	3	Modine Mfg. Co. (owner #2)	1220	835	290	347	57
11146N05E33.8b	2	Dean Foods Co. (owner #1)	1783	880	618	676	58
11146N05E33.8b	4	Dean Foods Co.	825	880	639	658	19

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Ogle							
14124N10E24.2h	2	Comm. Ed. - Byron Station (Owner #1)	1500	875	627	627	0
14124N10E24.4h	1	Comm. Ed. - Byron Station (Owner #2)	1500	860			
14124N11E01.2b	1	Stillman Valley	300	733	696	697	1
14124N11E01.3a	2	Stillman Valley	460	747	693	693	0
14125N11E31.4e	2	Byron School District #226	250	718		668	
14125N11E31.5h	3	Byron School District #226	418	728		682	
14140N01E12.6a	2	Hillcrest	406	835		760	
14140N01E12.6b	1	Hillcrest	387	825	763	765	2
14140N01E23.2d	5	Rochelle	502	810	742	751	9
14140N01E23.3b	1	Del Monte Corp., Plant 110	494	793	602	758	156
14140N01E24.5h	7	Rochelle	925	795	710	734	24
14140N01E24.7a	4	Rochelle	1450	793	693	716	23
14140N01E25.2h	9	Rochelle	888	785	705	730	25
14140N01E25.3f	6	Rochelle	867	800	726	729	3
14140N01E26.5h	3	Del Monte Corp., Plant 109	420	778	700	755	55
14140N01E36.2h	10	Rochelle	920	785		710	
14140N02E21.1e	1	Hughes Hybrid Company	452	840	781		
14140N02E23.1f	2	Creston	737	905	792	796	4
14140N02E23.2f	3	Creston	724	905	704	806	102
14140N02E30.3b	8	Rochelle	935	793	672	690	18
Will							
19732N09E01.6b	2	Lakewood Shores	700	561		322	
19732N09E01.6c	3	Lakewood Shores	700	562	292		
19732N09E01.6d	4	Lakewood Shores	700	564	284		
19732N09E01.7f	1	Lakewood Shores	700	558		306	
19732N09E05.6d	3	Braidwood	1733	560	146	303	157
19732N09E05.6d	4	Braidwood	795	560		294	
19732N09E08.5c	1	Braidwood	1025	575	130		
19732N09E08.5d	2	Braidwood	846	572		280	
19732N09E08.6g	5	Braidwood	805	567		267	
19732N09E19.3h	1	Comm. Ed. Braidwood Station	1753	599	355		
19732N09E28.1d	2	Comm. Ed. Braidwood Training Ctr.	1690	594	353	354	1
19732N10E36.2d	3	Illinois Youth Center	1700	610	341	273	-68
19733N09E01.5e	5	Joliet Army Ammunition Plant	935	570	250	252	2
19733N09E25.6b	2	Wilmington	1566	546	203		
19733N09E36.7h	3	Wilmington	1578	530		289	
19733N10E09.1f	902	Joliet Army Ammunition Plt Well 1 (East)	1672	646		360	
19733N10E09.4h	901	Joliet Army Ammunition Plt Well 2 (West)	1645	641		364	
19734N09E03.1a	4	Amoco Chemical Corp.	1415	570	-39		
19734N09E09.4a	1	Channahon	765	570	206	266	60
19734N09E10.1h	2	Amoco Chemical Corp.	1405	568	-60	-27	33
19734N09E11.2d	2	Stepan Chemical Co.	1402	520	-10		
19734N09E11.2e	3	Stepan Chemical Co.	1410	525	-91		
19734N09E11.8f	3	Amoco Chemical Corp.	1400	575	-20		
19734N09E21.2d	1	BASF Corp.	1573	545	245	219	-26
19734N09E21.8a	2	Van Den Bergh Foods Co.	1555	530	230	240	10
19734N09E21.8b	1	Van Den Bergh Foods Co.	1555	530	110	264	154
19734N09E22.7d	1	Mobil Oil Corp.	1578	555		263	
19734N09E25.5d	9	Joliet Army Ammunition Plant	1603	590	225		
19734N09E25.5h	10	Joliet Army Ammunition Plant	1569	591	235		
19734N09E28.5h	1	Dow Chemical Co.	1605	534	205	214	9
19734N09E30.5d	4	Channahon	1647	603		247	
19734N09E34.7d	2	Hager Wood Preserving	1593	530	200	248	48
19734N09E35.8a	2	Joliet Army Ammunition Plant	1612	532	242		
19734N09E36.5a	6	Joliet Army Ammunition Plant	1653	578	213		

Appendix (continued)

County location	Well No.	Owner	Depth ft.	Surface elev.	Water-level elevation 1991	Water-level elevation 1995	Water-level changes, ft. 1991-1995
Will (cont'd)							
19734N09E36.5e	7	Joliet Army Ammunition Plant	1649	601	246		
19734N10E07.1a	1	Liquid Carbonic Corp.	1630	620	45		
19734N10E07.5a	1	Peoples Gas SNG Plant	1581	609	49	52	3
19734N10E07.6b	2	Peoples Gas SNG Plant	1597	609	40	29	-11
19734N10E31.7a	12	Joliet Army Ammunition Plant	1709	625		244	
19734N11E17.5d	6	Manhattan	1703	685		164	
19735N09E01.3e	11	Joliet (11D, Gael Drive)	1623	619	-216	-246	-30
19735N09E09.3c	2	Shorewood	1499	605	-5	100	105
19735N09E10.3a	2	Days Inn	1556	570	-30		
19735N09E11.1b	10	Joliet (10D)	1572	610	-139	-235	-96
19735N09E25.1e	3	Caterpillar Tractor Co.	1556	547		-71	
19735N10E02.8b	4	Joliet (4D)	1608	558	-277	-162	115
19735N10E03.4e	3	Joliet Correctional Center	1600	560	-148	-150	-2
19735N10E03.5e	2	Joliet Correctional Center	1550	549	-140		
19735N10E04.2h	1	Sheffield Steel	1595	553	-42		
19735N10E07.4b	9	Joliet (9D, Campbell St)	1671	647	-206		
19735N10E09.1d	1	Joliet (ID, Ottawa ST)	1621	536	-130	-154	-24
19735N10E11.7g	1	EJ & E Railroad	1589	560	-30		
19735N10E14.5d	3	Ivex Corp. Well #2	1639	593		-111	
19735N10E14.6h	5	Joliet (5D)	1608	564	-188	-91	97
19735N10E16.2h	604	Joliet (Des Plaines St)	1575	531	-93	-87	6
19735N10E16.5c	3	Joliet (3D, Jasper St)	1565	537	-241	-218	23
19735N10E19.2b	4	Comm. Ed. - Sta. 29, Units 7,8	1525	523	-182	-160	22
19735N10E20.6a	2	Comm. Ed. - Sta. 9, Unit 5	1487	536	-137		
19735N10E20.7g	2	Rockdale	1586	556		-119	
19735N10E22.8g	1	Joliet Equipment	1608	569	256	242	-14
19735N10E29.8e	5	Olin Co.	1535	567		-114	
19735N10E29.8h	5	Comm. Ed. - Station 9, Units 7,8	1505	527	-54		
19735N10E30.1c	4	Olin Co.	1555	583		-30	
19735N10E30.1e	1	Olin Co.	1520	548	-323		
19735N10E30.1e	2	Olin Co.	1510	550	-290	-178	112
19735N10E30.2h	3	Comm. Ed. - Sta. 29, Units 7,8	1525	510	-96		
19735N10E30.6e	2	Caterpillar Tractor Co.	1543	546	-189	-134	55
19735N10E30.7f	1	Caterpillar Tractor Co.	1560	544	-106		
19735N11E05.7h	8	Joliet (8D, Hadley Valley)	1660	648	-244	-147	97
19735N11E08.8h	7	Joliet (7D, Hadley Valley)	1701	674	-133	-171	-38
19736N09E04.4a	4	Plainfield	1443	620	-81	46	127
19736N09E10.7d	3	Plainfield	1481	612	-78	1	79
19736N09E16.2a	5	Plainfield	1508	604	-18	17	35
19736N09E25.6d	12	Joliet (12D, Homart Site)	1557	602	-106	-128	-22
19736N10E02.7f	1	Comm. Ed. - Station 18	1500	587	-93	-52	41
19736N10E02.8f	3	Comm. Ed. - Station 18	1507	590	-64	-39	25
19736N10E02.8h	2	Comm. Ed. - Station 18	1536	590		-26	
19736N10E04.6g	4	Romeoville	1524	670	-149	-60	89
19736N10E16.4e	3	Joliet Regional Port Dist. Airport	1523	666	-78	-33	45
19736N10E21.3a	6	Stateville Correctional Center	1611	642	-233		
19736N10E23.6d	2	Lockport	1555	589		-91	
19736N10E27.7b	1	Metropolitan Water Reclamation Dist.	852	547	-88	-82	6
19736N10E28.1b	1	Alcan Ingot and Powder	1546	563	-133		
19736N10E28.6f	4	Stateville Correctional Center	1566	640	-157	-131	26
19736N10E29.2g	5	Stateville Correctional Center	1653	645		-20	
19736N10E33.6h	1	Hendrickson Stamping	1558	593	-132	-98	34
19736N11E31.8a	6	Joliet (6D, Hadley Valley)	1656	642	-154	-229	-75
19737N09E12.8c	21	Naperville	1441	645	-45		
19737N09E13.5a	1	Naperville Golf Course	1485	638		83	
19737N10E25.7a	3	Unocal Corp. Chicago Refinery	1501	600	-44		

Appendix (continued)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Will (cont'd)							
19737N10E25.7c	4	Unocal Corp. Chicago Refinery	1480	590	-46		
19737N10E29.7h	10	Romeoville	1505	640		8	
19737N10E33.1h	2	Romeoville	1520	640	-152	-29	123
19737N10E35.3c	1	Unocal Corp. Chicago Refinery	1460	585	-168		
19737N10E35.3c	2	Unocal Corp. Chicago Refinery	1460	585	-183		
Winnebago							
20143N01E03.7a	34	Rockford	1485	740		661	
20143N02E04.3a	43	Rockford	1500	812		597	
20143N02E17.7h	36	Rockford (Unit Well 36)	1505	864	558	585	27
20144N01E02.3b	3	Rockford (Unit Well 3)	1127	760	635	661	26
20144N01E09.1c	20	Rockford (Unit Well 20)	1200	735	615		
20144N01E11.1d	1	Essex International Inc.	1150	740	685		
20144N01E12.6b	1	Ingersoll Milling Machine Co.	729	746	663	662	-1
20144N01E14.5h	37	Rockford	1434	740		657	
20144N01E15.3c	1	Dean Foods Co.	1125	725	643	688	45
20144N01E17.2d	22	Rockford (Unit Well 22)	1381	760	633	625	-8
20144N01E20.7f	21	Rockford (Unit Well 21)	1205	820	648	650	2
20144N01E21.1e	15	Rockford (Unit Well 15)	1355	810	594	623	29
20144N01E23.6d	801	Rockford (Beattie Pk/Obs Well)	1300	708	686	693	7
20144N01E27.1e	2	Reed Chatwood, Inc.	450	705	665	690	25
20144N01E28.5c	18	Rockford (Unit Well 18)	1380	820	634	649	15
20144N01E33.8f	1	Muller Pinehurst Dairy	482	760	726	727	1
20144N01E33.8f	2	Muller Pinehurst Dairy	465	759	720		
20144N01E34.6h	4	Rockford (Unit Well 4)	1219	730	647	665	18
20144N02E03.4c	30	Rockford (Unit Well 30)	1325	905	578	568	-10
20144N02E07.7e	1	Woodward Governor Co.	1227	725	700	659	-41
20144N02E07.7e	2	Woodward Governor Co.	732	725		637	
20144N02E08.2g	29	Rockford (Unit Well 29)	1357	845	597	576	-21
20144N02E09.3a	25	Rockford (Unit Well 25)	1290	878	610	583	-27
20144N02E11.5g	39	Rockford (Unit Well 39)	1500	890		593	
20144N02E14.5d	31	Rockford (Unit Well 31)	1505	880		579	
20144N02E16.2a	27	Rockford (Unit Well 27)	1280	840	569	554	-15
20144N02E17.6g	17	Rockford (Edgebrook #3)	1195	785		628	
20144N02E18.7a	5	Rockford (Unit Well 5)	1312	792	600	565	-35
20144N02E20.4h	13	Rockford (Unit Well 13)	1457	835	593	557	-36
20144N02E23.1a	3	Best Western Clock Tower Inn	860	818	612	591	-21
20144N02E23.1d	40	Rockford	1466	855		603	
20144N02E25.7g	1	Rockford Park District	1185	793	598	613	15
20144N02E28.5h	26	Rockford (Unit Well 26)	1326	835	632	620	-12
20144N02E29.3a	10	Rockford (Unit Well 10)	1426	865	588	576	-12
20144N02E31.7f	6	Rockford (Unit Well 6)	1372	790	652	682	30
20144N02E32.4a	16	Rockford (Unit Well 16)	1310	840	592	566	-26
20144N02E34.3h	42	Rockford	1500	830		549	
20144N02E35.5e	3	Cherry Valley	682	800	670	657	-13
20144N02E35.6h	2	Cherry Valley	1206	800	655	640	-15
20144N02E35.8e	1	Cherry Valley	1201	800	648	635	-13
20145N02E26.1a	5	Loves Park	1390	890		655	
20145N02E33.3a	4	Loves Park	1313	888	680	625	-55
20145N02E34.4g	3	Loves Park	863	885	845	840	-5
20146N01E12.5a	904	Beloit Corp. Welding & Res. Dept.	550	730		720	
20146N01E24.8a	6	Rockton	728	828	718	728	10
20146N02E05.7d	3	Wis. Pwr & Lght Co. (S Beloit)	1200	745	692	690	-2
20146N02E06.5q	5	Wis. Power & Light Co.	1225	779	691		
20146N02E15.5b	1	Colt Industries	301	820	775	775	0
20146N02E18.8a	1	Woodward Governor C. - Air	601	765		725	

Appendix (concluded)

County location	*Well no.*	*Owner*	*Depth ft.*	*Surface elev.*	*Water-level Elevation 1991*	*Water-level elevation 1995*	*Water-level changes, ft. 1991-1995*
Winnebago (cont'd)							
20146N02E18.8a	2	Woodward Governor C. - Air	600	765		703	
20146N02E19.7g	7	Rockton	594	753		628	
20146N02E28.1b	6	North Park Public Water Dist.	780	750	686	686	0
20146N02E29.1b	7	North Park Public Water Dist.	780	750	638	681	43

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