

ISWS/BUL-60(25)/78

BULLETIN 60-25

STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION



Public Groundwater Supplies
in Warren County

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ILLINOIS STATE WATER SURVEY

URBANA

1978

PUBLIC GROUNDWATER SUPPLIES IN WARREN COUNTY

by Dorothy M. Woller, Karen L. Kunz, and Ellis W. Sanderson

Introduction

This publication presents all available information on production wells used for public groundwater supplies in Warren County. Bulletin 60, which is divided by county into separate publications, supersedes Bulletin 40 and its Supplements 1 and 2.

The definition of public water supply as contained in the Environmental Protection Act of 1970 was used to determine those water systems and wells to be included. Systems and wells described furnish water for drinking or general domestic use in: 1) incorporated municipalities; 2) unincorporated communities where 10 or more separate lots or properties are being served or are intended to be served; 3) state-owned parks and memorials; and 4) state-owned educational, charitable, or penal institutions.

This report includes separate descriptions for 6 groundwater supplies furnishing water to 5 municipalities and 1 subdivision in Warren County. These are preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for public use. An explanation of the format used in the descriptions is also given.

Acknowledgments. This report was prepared under the general direction of Dr. William C. Ackermann, Chief of the Illinois State Water Survey, and Richard J. Schicht, Head of the Hydrology Section. Mrs. J. L. Ivens and Mrs. P. A. Motherway edited the manuscript, Mrs. Marilyn J. Innes typed the camera-copy, and John W. Brother, Jr. supervised the preparation of the illustrations. The chemical analyses, unless otherwise stated, were made by personnel of the Water Survey Chemistry Section under the supervision of Laurel M. Henley. The analyses made by personnel of the Illinois Environmental Protection Agency were under the supervision of Ira M. Markwood. Thanks are due to M. L. Sargent of the Illinois State Geological Survey who prepared the generalized column of rock stratigraphic units and aquifers and, with R. D. Brower, reviewed the geological information in the manuscript. Grateful acknowledgment also is given to consulting engineers, well drillers, water superintendents, and municipal officials who have provided valuable information used in this report.

Groundwater Geology

The geology of Warren County is described generally in Illinois State Geological Survey Circular 222, *Groundwater Geology in Western Illinois, North Part* and Report of Investigation 221, *Ground-Water Geology of the Rock Island, Monmouth, Galesburg, and Kewanee Area, Illinois*. The following brief discussion of geologic conditions in the county is taken largely from these publications. More detailed information on the geology in this portion of the state, can be provided by the State Geological Survey which is located on the University of Illinois campus, Urbana.

Glacial drift deposits blanket Warren County and form the present land surface. In the upland areas of the county, the drift is generally less than 50 ft thick and is extensively dissected by tributaries of the Mississippi and Spoon Rivers. Water-bearing sand and gravel deposits are rarely encountered.

Beneath the glacial drift deposits, the upper bedrock surface consists principally of beds of limestone and shale. The rock units underlying Warren County range in geologic age from Pennsylvanian to Precambrian (upper units shown on generalized stratigraphic sequence in figure 1).

Pennsylvanian-age rocks underlie the glacial drift in the entire southern one-third, much of the northeast and east area, and scattered parts of the rest of the county. These rocks range in thickness from as much as 160 ft at the north edge of the county to a featheredge where they have been eroded. They consist principally of shale and are not regarded as water yielding in this area.

The Burlington-Keokuk Limestone (Mississippian age) is the upper bedrock unit beneath most of the west-central part of the county except in the northwestern corner where

SYSTEM	SERIES	GROUP OR FORMATION	AQUIFER	LOG	THICKNESS (ft)	GENERALIZED DESCRIPTION	
QUATERNARY	PLEISTOCENE		Sands and Gravels		0-200	Till, gravel, sand, silt, peat, loess	
					0-160	Shale, sandstone, clay, limestone, coal	
MISSISSIPPIAN	VALMEYERAN	Burlington-Keokuk	Burlington-Keokuk		0-200	Limestone, white to brown, very cherty, fossiliferous, dolomitic	
	KINDERHOOKIAN	New Albany			0-290	Shale, green to brown, pyritic, <i>Sporangites</i> , little sandstone and dolomite	
DEVONIAN	UPPER					75-160	Limestone and dolomite, silty, cherty, fine gray to buff, part slightly pyritic
	MIDDLE	Cedar Valley-Wapsipinicon	Silurian-Devonian	0-125		Dolomite, crystalline, vesicular, white to gray, partly cherty	
SILURIAN	NIAGARAN	Racine-Marcus				0-25	Dolomite, dense to vesicular, silty and sandy in lower part
	ALEXANDRIAN						
ORDOVICIAN	CINCINNATIAN	Mequoketa			105-200	Shale, dolomitic, green to gray, some dolomite	
	CHAMPLAINIAN	Galena	Galena-Platteville		225-235	Dolomite and limestone, medium-grained, cherty in lower part	
		Platteville			40-70	Dolomite, fine-grained, cherty	
		Glenwood-St. Peter	Glenwood-St. Peter		130-200	Sandstone, medium-grained, friable, mostly white	
	CANADIAN	Shakopee	Shakopee		Cambrian-Ordovician Aquifer System	200-300	Dolomite, cherty, few sandstone beds
		New Richmond	New Richmond			20-50	Sandstone, some dolomite
		Oneota	Oneota			220-240	Dolomite, cherty, medium crystalline
Gunter			0-25	Sandstone, dolomitic			
CAMBRIAN	CROIXAN	Eminence	Eminence-Potosi		80-90	Dolomite, light colored, sandy, thin sandstones	
		Potosi			160-210	Dolomite, fine-grained, gray to brown, drusy quartz	
		Franconia	Franconia		200-250	Dolomite, sandstone and shale, glauconitic, green to red, micaceous	
		Ironton	Ironton-Galesville		120-160	Sandstone, fine to coarse-grained, well sorted, upper part dolomitic	
		Galesville					

Figure 1. Generalized column of rock stratigraphic units and aquifers in Warren County
(Prepared by M. L. Sargent, Illinois State Geological Survey)

it has been eroded exposing the underlying New Albany Shale Group. The Burlington-Keokuk is exposed at land surface in some of the creek valleys but is usually at a depth of about 100 to 200 ft. It ranges in thickness from 0 to 200 ft. The yield capability of the Burlington-Keokuk depends on the number, size, and degree of interconnection of water-filled cracks and crevices within the rocks that are intersected by the well bore. Quantities of water adequate for domestic and farm use can usually be obtained and, locally, supplies for small communities may be available for development.

The New Albany Shale Group (Mississippian-Devonian age) underlies the Burlington-Keokuk and separates it from deeper water-yielding units. It usually ranges from about 100 to 290 ft in thickness, except where it is absent in a small area in the northwest corner of the county.

The Silurian-Devonian (Hunton Megagroup) limestone and dolomite units occur below the New Albany Shale Group. They lie at depths from about 200 ft in the northwest area to as much as 600 ft in the southern part of the county. They range in thickness from about 300 ft in the northeast to about 100 ft in southeastern Warren County. Water from these limestone and dolomite units is obtained from cracks and crevices in the rocks that are intersected by the well bore. The water is highly mineralized.

The Maquoketa Group (Ordovician age) underlies the Silurian-Devonian aquifer and consists primarily of nonwater-bearing shales. It is about 105 to 200 ft thick and separates the Silurian-Devonian aquifer from deeper water-yielding units:

A thick sequence of hydrologically connected rock units known as the Cambrian-Ordovician aquifer system underlies the Maquoketa Group. This aquifer system consists in downward order of the Galena-Platteville Dolomite Groups, Glenwood-St. Peter Sandstone, Prairie du Chien Group, Eminence-Potosi Dolomite, Franconia Formation, and Ironton-Galesville Sandstone. Water supply wells in Warren County have not penetrated below the Ironton-Galesville Sandstone.

The Galena-Platteville Dolomite Groups (Ordovician age) lie at depths from about 600 to 790 ft and have a relatively uniform thickness of about 300 ft or less. Water from these units is also obtained from cracks and crevices intersected by the well bore. Moderate quantities of water (50 to 100 gpm) are usually obtained but the water is highly mineralized.

The Glenwood-St. Peter Sandstone (Ordovician age) lies below the Galena-Platteville at depths from about 900 ft in the southwest to about 1100 ft in the north central region near Monmouth. The limited data available suggest this aquifer is about 130 to 200 ft thick in Warren County. The Glenwood-St. Peter is one of the more reliable aquifers in this part of Illinois and is capable of yielding moderate quantities (50 to 150 gpm) of water. The water is highly mineralized in this area.

Below the Glenwood-St. Peter lie the Prairie du Chien Group, Eminence-Potosi Dolomite, and Franconia Formation which consists of interbedded dolomites, shales, and sandstones. These units are encountered at depths from about 1250 ft in the north central to about 1300 ft in the southeast and have total thicknesses varying from about 1100 to 1300 ft. The shales and dolomites yield little water, but the sandy parts of these units may contribute small to moderate quantities of highly mineralized water.

The Ironton-Galesville Sandstone (Cambrian age) is the most consistently permeable and productive unit of the Cambrian-Ordovician aquifer system in northern Illinois. In Warren County it lies at depths of about 2200 to 2500 ft and is about 120 to 160 ft thick. The water is highly mineralized.

Groundwater Development for Public Use

Groundwater is used as a source for 6 public water supply systems serving Alexis, Kirkwood, Little Swan Lake Subdivision, Little York, Monmouth, and Roseville. The locations of these supplies are shown in figure 2.

Sand and gravel deposits are tapped as a source of water for Roseville. Presently a horizontal collector at a depth of about 6 ft below a stream valley is in use. Production in 1977 was estimated to be about 145,000 gpd. Analyses of water from the collector indicate that the iron content is 0.0 mg/l and the hardness ranges from 179 to 205 mg/l. Water for Roseville is chlorinated and fluoridated.

The Burlington-Keokuk Limestone aquifer (Mississippian age) is open to the bore hole in Little Swan Lake Subdivision Well No. 1 but no wells tap only this unit.

Deeper lying bedrock aquifer units are tapped for water supply at Alexis, Kirkwood, Little Swan Lake Subdivision, Little York, and Monmouth. In these wells various combinations of Devonian, Silurian, Ordovician, and Cambrian age aquifer units are open to the bore hole with each contributing a portion of the water withdrawn. Water obtained from many of these bedrock aquifer units in Warren County is highly mineralized with one or more mineral constituents exceeding the primary or secondary standards of the USEPA Interim Drinking Water Regulations. Fluoride, radium, sulfate, chloride, and the total mineral content are among the constituents that may be greater than the allowable or recommended limits. Sufficient data are not available to determine the specific aquifer unit that contributes water with the greatest concentrations of each mineral constituent.

The Silurian-Devonian limestone and dolomite units are tapped as a source of water at Little Swan Lake Subdivision and by Little York Well No. 1. Little Swan Lake Subdivision Well No. 1 is also open to the Burlington-Keokuk and the wells at Alexis and Kirkwood are open to the Silurian-Devonian as well as to deeper aquifer units. There are presently 6

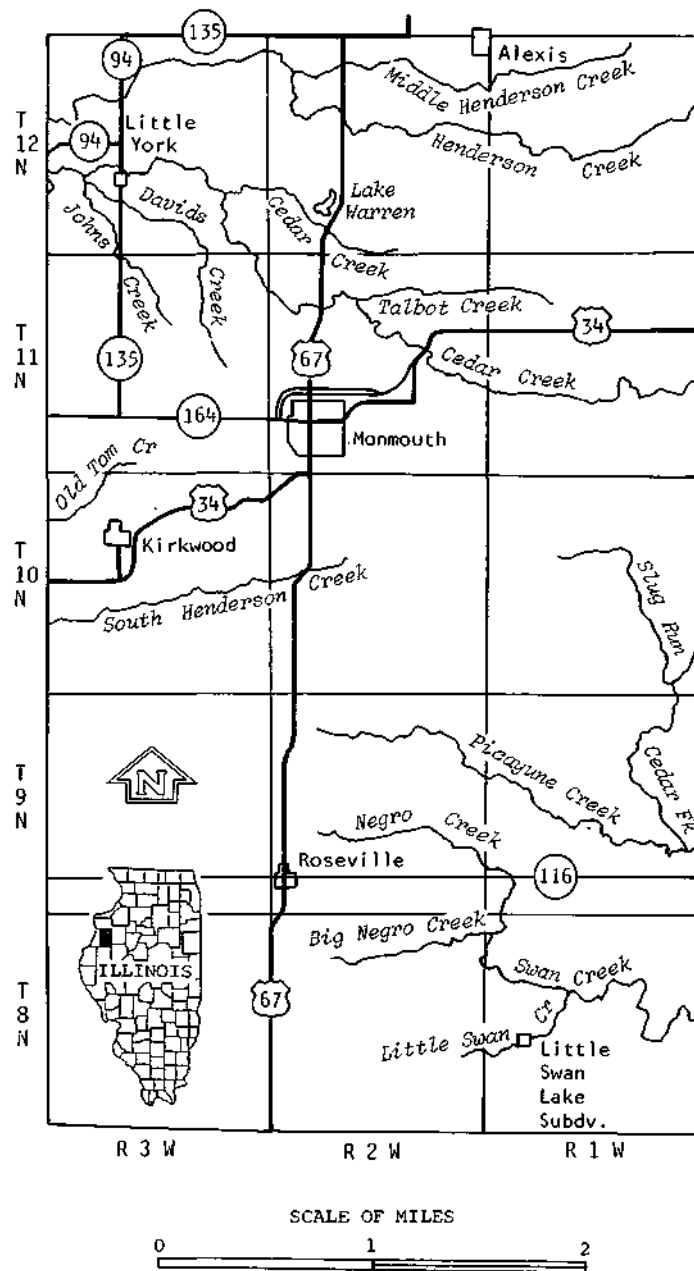


Figure 2. Location of public groundwater supplies in Warren County

production wells ranging in depth from 326 to 723 ft finished in the Silurian-Devonian aquifer. They reportedly are pumped at rates of 30 to 50 gpm. Production from these wells in 1977 was estimated to be about 9000 gpd. Analyses of water from these wells indicate that the iron content ranges from 0.0 to 2.6 mg/l, sodium from 55 to 550 mg/l, fluoride from 0.1 to 3.6 mg/l, chlorides from 1 to 420 mg/l, hardness from 7 to 370 mg/l, and the total dissolved minerals from 490 to 1490 mg/l. Water from Little Swan Lake Subdivision Well No. 1

and Little York is chlorinated.

The Galena-Platteville dolomite is tapped as a source of water by Kirkwood Well No. 4 and is the deepest unit open to the bore hole in Little York Well No. 3. These two wells are 1069 and 872 ft deep and are pumped at rates of 35 to 95 gpm. Alexis Well No. 1 and Kirkwood Well No. 5 are open to the Galena-Platteville as well as to the underlying Glenwood-St. Peter Sandstone. Alexis Well No. 2 is open to these two units and the Shakopee Dolomite. These three

production wells range in depth from 1204 to 1215 ft and are pumped at rates of 50 to 350 gpm. Production in 1977 from the wells finished in the Galena-Platteville, the Glenwood-St. Peter, or the Shakopee was estimated to be about 154,000 gpd. Analyses of water indicate that the iron content ranges from 0.1 to 2.6 mg/l, sodium from 153 to 666 mg/l, fluoride from 0.9 to 3.4 mg/l, chlorides from 56 to 285 mg/l, sulfates from 213 to 875 mg/l, hardness from 214 to 419 mg/l, and the total dissolved minerals from 765 to 2201 mg/l. Water for Alexis is chlorinated and water for Kirkwood is chlorinated and filtered.

All units of the Cambrian-Ordovician aquifer system are tapped by the Monmouth supply wells except that in Well Nos. 7 and 8 the Glenwood-St. Peter Sandstone is cased and is not open to the bore hole. The 5 production wells in use at Monmouth range in depth from 2445 to 2465 ft and are pumped at rates of about 1000 gpm. Production from the wells was about 2,300,000 gpd in 1977. Analyses of water show that the iron content ranges from about 0.1 to 0.7 mg/l, sodium from 231 to 400 mg/l, fluoride from 1.5 to 4.0 mg/l, chlorides from 103 to 180 mg/l, sulfates from 289 to 860 mg/l, hardness from 237 to 506 mg/l, and total dissolved minerals from 905 to 1770 mg/l. The water is chlorinated, treated with polyphosphate to keep iron in solution, and aerated to remove hydrogen sulfide.

Total municipal pumpage in Warren County in 1977 was about 2,608,000 gpd. Pumpage from the sand and gravel deposits was about 5.6 percent (145,000 gpd) of this total, from wells finished in the Devonian-Silurian units about 0.3 percent (9000 gpd), from wells finished in the Galena-Platteville or Glenwood-St. Peter units about 5.9 percent (154,000 gpd), and from wells tapping the Cambrian-Ordovician aquifer system about 88.2 percent (2,300,000 gpd).

FORMAT

In this publication the descriptions of public groundwater supplies are presented in alphabetical order by place name.

At the beginning of each description the U. S. Census of population for 1970 is given for incorporated places. For unincorporated places, the population is estimated on the basis of the number of services or residential units and an assumed number of 3.5 persons per service.

The number of services and quantity of water distributed at each supply are given where available for the earliest and the latest reported values.

Individual production wells for each supply are described in the order of their construction. The description for each

well includes the *aquifer or aquifers tapped, date drilled, depth, driller, legal location, elevation in feet above mean sea level, log, construction features, yield, pumping equipment, and chemical analyses.*

When available, sample study logs prepared by the Illinois State Geological Survey are presented. When these are not available, drillers logs are used as reported. Commonly used drillers terms such as clay, silt, or pebbly clay generally are synonymous with the glacial tills tabulated by the State Geological Survey. Similarly, limestones or dolomites reported by drillers usually are carbonate rocks which in most of Illinois are dolomitic in composition. When stating the bedrock aquifers tapped by a well, the sample study log provided by the State Geological Survey and the drillers casing record are used to determine the geohydrologic units open to the hole. If only a drillers log is available and the geohydrologic units cannot be readily determined, only the principal rock type as described by the driller is given (dolomite, sandstone, etc.).

The screen sizes given in this publication are for continuous slot type screens. Slot sizes given indicate the width of the slot openings in thousandths of an inch. For example, a 20 slot screen has slot openings 0.020 in. wide and a 100 slot screen has slots 0.100 in. wide.

Abbreviations Used

est.....	.....estimated
ft.....	.....foot (feet)
gpd.....	.....gallons per day
gpm.....	.....gallons per minute
hp.....	.....horsepower
hr.....	.....hour(s)
ID.....	.....inside diameter
in.....	.....inch(es)
Lab.....	.....laboratory
lb.....	.....pound(s)
me/l.....	.....milliequivalents per liter
mg/l.....	.....milligrams per liter
min.....	.....minute(s)
No.(s).....	.....number(s)
OD.....	.....outside diameter
pc/l.....	.....picocuries per liter
R.....	.....range
rpm.....	.....revolutions per minute
T.....	.....township
TDH.....	.....total dynamic head

ALEXIS

The village of Alexis (946) installed a public water supply in 1895. One well (No. 2) is in use and another well (No. 1) is available for emergency use. In 1950 there were 200 services, none metered; the average daily pumpage was 25,000 gpd. In 1977 there were 440 services, all metered; the average and maximum daily pumpages were 72,000 and 110,000 gpd, respectively. The water is chlorinated.

Initially, water was obtained from a well completed about 1895 to a depth of 100 ft. This well was abandoned prior to 1915.

WELL NO. 1, open to the Devonian limestone, Silurian dolomite, Galena-Platteville dolomite, and the Glenwood-St. Peter Sandstone, was completed in 1898 to a depth of 1204 ft (reported to be 1200 ft deep in 1928) by the J. P. Miller Artesian Well Co., Brookfield. This well is available for emergency use. The well is located about 110 ft south and 140 ft east of the intersection of First North and Main Sts., approximately 110 ft S and 1274 ft W of the NE corner of Section 1, T12N, R2W. The land surface elevation at the well is approximately 700 ft.

A correlated drillers log of Well No. 1 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Clay	65	65
PENNSYLVANIAN SYSTEM		
Sandstone	40	105
Soapstone and limestone streak	5	110
PENNSYLVANIAN AND MISSISSIPPIAN SYSTEMS		
Shale	238	348
DEVONIAN AND SILURIAN SYSTEMS		
Limestone and dolomite	222	570
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale and limestone	160	730
Galena-Platteville Groups		
Limestone	326	1056
St. Peter Sandstone		
Sandstone	144	1200

The well is cased with 8-in. steel pipe from about 3 ft above land surface to a depth of 64 ft and 6-in. steel pipe from land surface to a depth of 345 ft.

In 1915, the nonpumping water level was reported to be about 70 ft below land surface.

In 1928, this well was rehabilitated by the J. P. Miller Artesian Well Co. The well was cleaned, the old 6-in. casing was removed and replaced, and the pump cylinder and rods were repaired and reinstalled.

Nonpumping water levels were reported to be 123 ft in June 1930, 90 ft below land surface in 1934, 80 ft below land surface in November 1946, and 183 ft in 1960.

The pumping equipment presently installed is a Sumo submersible pump set at 250 ft, rated at 50 gpm, and powered by a 10-hp electric motor.

A mineral analysis of a sample (Lab. No. 112719) collected

November 26, 1947, after pumping for 1 hr, showed the water to have a hardness of 299 mg/l, total dissolved minerals of 765 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 2, open to the Devonian limestone, Silurian dolomite, Galena-Platteville dolomite, Glenwood-St. Peter Sandstone, and the Shakopee Dolomite, was completed in February 1952 to a depth of 1215 ft by the Varner Well and Pump Co., Dubuque, Iowa. The well is located about 2 blocks southeast of Well No. 1, approximately 565 ft S and 675 ft W of the NE corner of Section 1, T12N, R2W. The land surface elevation at the well is approximately 700 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Glacial Drift		
Gravel and mud	29	29
Gravel	23	52
PENNSYLVANIAN SYSTEM		
Shale, dark; sand	81	133
Shale, brownish gray to dark gray, weak	77	210
MISSISSIPPIAN SYSTEM		
Burlington Limestone		
Chert, oolitic, white	5	215
MISSISSIPPIAN-DEVONIAN SYSTEMS		
New Albany Group		
Shale, dark brown, weak	20	235
Shale, gray to dark gray	65	300
Dolomite, argillaceous; shale	20	320
DEVONIAN SYSTEM		
Cedar Valley Limestone		
Limestone, silty, light brown	20	340
Limestone, silty, gray; shale	15	355
Limestone, argillaceous, grayish brown	26	381
Wapsipinicon Limestone		
Limestone, white to brown, lithographic	30	411
Dolomite, brown, coarse	4	415
SILURIAN SYSTEM		
Niagara Series		
Dolomite, light gray, occasional pyrite	75	490
Dolomite, light gray	25	515
Dolomite, cherty, brownish gray	19	534
ORDOVICIAN SYSTEM		
Maquoketa Group		
Dolomite, argillaceous, dark gray	8	542
Shale, gray to brown, weak	63	605
Dolomite, argillaceous, dark brownish gray	70	675
Shale, dark grayish brown; dolomite	45	720
Galena Group		
Kimmswick Subgroup		
Dolomite, light gray; pyrite	80	800
Dolomite, brown; chert at base	134	934
Decorah Subgroup		
Dolomite, slightly sandy, light brown	11	945
Dolomite, cherty, reddish brown	14	959
Platteville Group		
Dolomite, cherty, brown	36	995
Limestone, light brown	10	1005
Dolomite, grayish brown	26	1031
Ancell Group		
Glenwood Formation		
Dolomite, sandy, grayish brown	4	1035
Sandstone, white, fine to coarse	80	1115
St. Peter Sandstone		
Sandstone, white, fine to coarse, incoherent	50	1165
Prairie du Chien Group		
Shakopee Dolomite		
Dolomite, sandy, pink	50	1215

A 19-in. diameter hole was drilled to a depth of 260 ft, reduced to 15 in. between 260 and 736 ft, and finished 12 in. in diameter from 736 to 1215 ft. The well is cased with 19-in. pipe from 1.5 ft above land surface to a depth of 120 ft, 15-in. pipe from 113 ft to a depth of 260 ft, 12-in. pipe from 2 ft above land surface to a depth of 328.2 ft, and a 12-in. liner pipe from 501 ft to a depth of 736 ft.

A production test was conducted on February 4-5, 1952, by representatives of the driller, the village, the State Water Survey, and Missman, Stanley, Farmer & Associates, Consulting Engineers. After 3 hr of pumping at rates ranging from 320 to 210 gpm, the drawdown was 110.0 ft from a nonpumping water level of 160.0 ft below the top of the casing. Five min after pumping was stopped, the water level had recovered to 182.0 ft. Intermittent pumping was continued for 22.3 hr at rates ranging from 171 to 282 gpm with a final drawdown of 138.0 ft. Forty-five min after pumping was stopped, the water level had recovered to 165.5 ft.

The well was shot with two nitrogel explosive charges (300 lb each) between the depths of 1040 to 1050 ft and between 1133 to 1143 ft. A production test was then conducted on February 28, 1952, by representatives of the driller, the village, the State Water Survey, and Missman, Stanley, Farmer & Associates. After 5.4 hr of pumping at rates ranging from 210 to 365 gpm, the drawdown was 56 ft from a nonpumping water level of 159 ft below the top of the casing. Eight min after pumping was stopped, the water level had recovered to 167 ft. Pumping was continued for

3.8 hr at rates ranging from 570 to 385 gpm with a final drawdown of 78 ft. Fifteen min after pumping was stopped, the water level had recovered to 164 ft.

In 1958, after pumping at a rate of 370 gpm, the drawdown was 60 ft from a nonpumping water level of 180 ft.

The pumping equipment presently installed is a Sumo submersible pump set at 294 ft, rated at 350 gpm, and powered by a 40-hp Sumo electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B116799) is for a water sample from the well collected December 10, 1974, after 30 min of pumping at 300 gpm.

WELL NO. 2, LABORATORY NO. B116799					
		mg/l	me/l		mg/l me/l
Iron	Fe	0.1		Silica	SiO ₂ 9
Manganese	Mn	0.0		Fluoride	F 1.8 0.10
Ammonium	NH ₄	1.7	0.09	Boron	B 1.0
Sodium	Na	284	12.35	Nitrate	NO ₃ 0.0 0.00
Potassium	K	11.0	0.28	Chloride	Cl 108 3.05
Calcium	Ca	49	2.44	Sulfate	SO ₄ 380 7.90
Magnesium	Mg	24	1.98	Alkalinity(as CaCO ₃)	303 6.06
Arsenic	As	0.00		Hardness (as CaCO ₃)	221 4.42
Barium	Ba	0.0			
Copper	Cu	0.01		Total dissolved	
Cadmium	Cd	0.00		minerals	1034
Chromium	Cr	0.00			
Lead	Pb	0.00		pH (as rec'd)	7.8
Mercury	Hg	0.0000		Radioactivity	
Nickel	Ni	0.0		Alpha pc//	12.5
Selenium	Se	0.00		± deviation	6.4
Silver	Ag	0.00		Beta pc//	19.6
Cyanide	CN	0.00		± deviation	4.8
Zinc	Zn	0.0			

KIRKWOOD

The village of Kirkwood (817) installed a public water supply in 1894. Two wells (Nos. 4 and 5) are in use. In 1950 there were 150 services, almost all metered; the average and maximum daily pumpages were 13,000 and 15,000 gpd, respectively. In 1977 there were 350 services, all metered; the average and maximum daily pumpages were 46,600 and 70,000 gpd, respectively. The water is chlorinated and filtered for iron removal.

Initially, water was obtained from a well completed in 1894 to a depth of 216 ft. This well, abandoned prior to 1917, was located about 1 block from the center of the business district. The well was cased with 6-in. pipe to a depth of 75 ft.

WELL NO. 1, open to sand and gravel, and the Burlington-Keokuk Limestone, was completed in 1907 to a depth of 127 ft. This well was abandoned prior to 1938 and sealed prior to 1973. The well was located in the western part of the village, approximately 300 ft N and 3300 ft E of the

SW corner of Section 8, T10N, R3W. The land surface elevation at the well is approximately 745 ft.

A drillers log of Well No. 1 follows:

Strata	Thickness (ft)	Depth (ft)
Soil and yellow clay	20	20
Clay, blue	67	87
Cemented sand and gravel	15	102
Limestone	10	112
Rock, yellow	5	117
Limestone	10	127

The well was cased with 6-in. pipe to a depth of 87 ft. Information on the well screen is not available.

WELL NO. 2, open to the Burlington-Keokuk Limestone, was completed to a depth of about 145 ft. This well was abandoned prior to 1938 and sealed prior to 1973. The well was located at the extreme north end of the principal north and south street in the village.

Information on the hole and casing is not available.

WELL NO. 3, open to the Burlington-Keokuk Limestone, was completed in 1931 to a depth of 145 ft by E. W. Johnson, Bloomington. This well has been disconnected from the system for several years. The well is located about 100 ft south of Walnut St. and 4 blocks west of Route 34, approximately 100 ft S and 3800 ft E of the NW corner of Section 17, T10N, R3W. The land surface elevation at the well is approximately 740 ft.

A correlated drillers log of Well No. 3 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Soil and clay	35	35
Clay, sand and gravel	80	115
MISSISSIPPIAN SYSTEM		
Limestone	20	135

The well is cased with 8-in. pipe to a depth of about 115 ft.

Upon completion, the well reportedly produced 50 gpm for 24 hr with a drawdown of 50 ft from a nonpumping water level of 30 ft.

On October 25, 1946, the nonpumping water level was reported to be about 30 ft.

The pumping equipment presently installed is a Red Jacket centri-jet pump (Serial No. W257) set at 120 ft, and powered by a 5-hp 3450 rpm General Electric motor.

A mineral analysis of a sample (Lab. No. 108091) collected October 25, 1946, after pumping for 15 min, showed the water to have a hardness of 434 mg/l, total dissolved minerals of 503 mg/l, and an iron content of 1.7 mg/l.

WELL NO. 4, open to the Galena-Platteville dolomite, was completed in September 1948 to a depth of 1069 ft by E. R. Hawkins & Son, Little York. The well is located in the treatment plant building, approximately 200 ft S and 4000 ft E of the NW corner of Section 17, T10N, R3W. The land surface elevation at the well is approximately 740 ft.

A sample study log of Well No. 4 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Glacial Drift		
Till (2 ft of blue sand at 70 ft)	100	100
MISSISSIPPIAN SYSTEM		
Keokuk Limestone		
Limestone, cherty, dolomitic, coarse	30	130
Burlington Limestone		
Limestone, cherty, dolomitic; dolomite	80	210
MISSISSIPPIAN-DEVONIAN SYSTEMS		
New Albany Group		
Shale, dolomitic, light gray, silty	250	460
DEVONIAN SYSTEM		
Cedar Valley Limestone		
Dolomite, silty, light brownish-gray	20	480
Limestone, dolomitic, light brownish-gray	35	515
Wapsipinicon Limestone		
Limestone, dolomitic, light gray	45	560

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
SILURIAN SYSTEM		
Dolomite, light gray to white, fine	30	590
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale, dolomitic, light gray	45	635
Shale, dolomitic, light olive gray	60	695
Galena-Platteville Groups		
Dolomite, brownish-gray, very fine	75	770
Dolomite, pale yellowish brown, very fine	110	880
Dolomite, cherty, pale yellowish brown	40	920
Dolomite, pale yellowish brown, very fine	55	975
Dolomite, cherty, pale yellowish brown	30	1005
Dolomite, cherty, light brown; shale, gray	20	1025
Limestone, gray; metabentonite; shale, blue	10	1035
Dolomite, cherty, buff, very fine	34	1069

A 10-in. diameter hole was drilled to a depth of 240 ft, reduced to 8 in. between 240 and 469.6 ft, reduced to 6 in. between 469.6 and 945 ft, and finished 5 in. in diameter from 945 to 1069 ft. The well is cased with 10-in. drive pipe from about 1 ft above the treatment plant floor to a depth of 101.5 ft, 8-in. pipe from land surface to a depth of 200 ft, 6-in. pipe from 200 ft to a depth of 469.6 ft, and 5.2-in. pipe from 455 ft to a depth of 945 ft (perforated from 923 to 945 ft).

Upon completion, the well reportedly produced 50 gpm with a drawdown of 157 ft from a nonpumping water level of 193 ft.

In 1952, the nonpumping water level was reported to be 219 ft.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 35 gpm, and powered by a 10-hp electric motor.

A mineral analysis of a sample (Lab. No. 115995) collected October 1, 1948, showed the water to have a hardness of 300 mg/l, total dissolved minerals of 2201 mg/l, and an iron content of 1.7 mg/l.

WELL NO. 5, open to the Devonian limestone, Silurian dolomite, Galena-Platteville dolomite, and the Glenwood-St. Peter Sandstone, was constructed in 1954 to a depth of 215 ft by the Hydromatics Corporation, Milan, and deepened in August 1958 to a reported depth of 1215 ft by C. L. Jennings, New London, Iowa. The well is located approximately 150 ft S and 1450 ft W of the NE corner of Section 17, T10N, R3W. The land surface elevation at the well is approximately 740 ft.

Originally, the well was cased with 8-in. pipe from 1 ft above land surface to a depth of 107 ft. After deepening, additional casing was reported to be 6-in. pipe from 185 ft to a depth of 477 ft and 5-in. pipe from 566 ft to a depth of 702 ft.

After deepening in 1958, the well reportedly produced 33 gpm with a drawdown of 15 ft from a nonpumping water level of 230 ft.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 80 gpm, and powered by a 10-hp electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B52252) is for a water sample from the well collected June 27, 1977, after 45 min of pumping at 75 gpm.

WELL NO. 5, LABORATORY NO. B52252

		<i>mg/l</i>		<i>me/l</i>		<i>mg/l</i>		<i>me/l</i>	
Iron	Fe	0.4		Silica	SiO ₂	9.8			
Manganese	Mn	0.02		Fluoride	F	3.4	0.18		
Ammonium	NH ₄	1.5	0.08	Boron	B	1.3			
Sodium	Na	360	15.66	Nitrate	NO ₃	0.0	0.00		
Potassium	K	14	0.36	Chloride	Cl	160	4.51		
Calcium	Ca	96	4.79	Sulfate	SO ₄	680	14.14		
Magnesium	Mg	40	3.29	Alkalinity(as CaCO ₃)		253	5.06		
Arsenic	As	0.00							
Barium	Ba	0.0		Hardness (as CaCO ₃)		417	8.34		
Copper	Cu	0.01							
Cadmium	Cd	0.00		Total dissolved minerals		1550			
Chromium	Cr	0.00							
Lead	Pb	0.01							
Mercury	Hg	0.0005							
Nickel	Ni	0.0							
Selenium	Se	0.00							
Silver	Ag	0.00							
Cyanide	CN	0.00							
Zinc	Zn	0.1		pH (as rec'd)		7.6			

LITTLE SWAN LAKE SUBDIVISION

Little Swan Lake Subdivision (est. 105), located about 5 miles west of Avon, installed two public water supplies. The water system is owned and operated by the homeowners. The first supply installed in 1969, consists of two wells (Nos. 1 and 2) each having a separate distribution system. The second supply, installed in 1974, consists of two wells (Nos. 4 and 5) each serving independent but interconnected distribution systems. In 1976 there were 38 services, none metered, served by the four wells. The water from Well No. 1 is chlorinated.

WELL NO. 1, open to the Burlington-Keokuk Limestone and the Devonian limestone, was completed in April 1969 to a depth of 680 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located near the east end of the subdivision south of the lake on Outlot D, approximately 2500 ft N and 2200 ft W of the SE corner of Section 20, T8N, R1W. The land surface elevation at the well is approximately 680 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil and yellow clay	46	46
Gray sandy mud	82	128
Shale	33	161
Limestone	179	340
Gray shale	105	445

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Brown shale	115	560
Gray shale	20	580
Gray limestone	25	605
Brown limestone	75	680

The well is cased with 8-in. black steel pipe from 2.5 ft above land surface to a depth of 163 ft and 5.5-in. black steel pipe from 320 ft to a depth of 620 ft. The hole was finished 5.5 in. in diameter at the bottom.

Upon completion, the well reportedly produced 35 gpm for 2 hr with a drawdown of 170 ft from a nonpumping water level of 128 ft below land surface.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 30 gpm, and powered by an electric motor.

A partial analysis of a sample (Lab. No. P-9364) collected May 7, 1969, showed the water to have a hardness of 62 mg/l, total dissolved minerals of 1244 mg/l, and an iron content of 0.45 mg/l.

WELL NO. 2, open to the Devonian limestone, was completed in May 1971 to a depth of 690 ft by Adolphson Well Drilling, Aledo. The well is located in the eastern part of the subdivision north of the lake on Outlot N, approximately 1200 ft S and 2200 ft E of the NW corner of Section 20, T8N, R1W. The land surface elevation at the

well is approximately 660 ft.

A drillers log of Well No. 2 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Yellow clay	45	45
Sand - wood - coal	48	93
Blue clay	18	111
Shale	42	153
Limestone	15	168
Lime and streaks of shale	15	183
Gray lime	59	242
Soft lime	30	272
Gray lime	88	360
Shale	236	596
Gray lime	34	630
Brown lime	60	690

An 8-in. diameter hole was drilled to a depth of 690 ft. The well is cased with 8-in. steel pipe from 2 ft above land surface to a depth of 168 ft and 6-in. pipe from 115 ft to a depth of 615 ft.

Upon completion, the well reportedly produced 35 gpm for 2 hr with a drawdown of 195 ft from a nonpumping water level of 133 ft below land surface.

A production test was conducted by the State Water Survey on September 8, 1976. After 2 hr of pumping at rates of 18 to 20 gpm, the final drawdown was 97.93 ft from a nonpumping water level of 142.55 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 149.35 ft. On the basis of the production test data, it was estimated that this well should yield 40 gpm (57,600 gpd) on a long-term basis.

The pumping equipment presently installed is a Red Jacket submersible pump set at 380 ft, rated at 50 gpm, and powered by a 7 1/2-hp electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B52254) is for a water sample from the well collected June 27, 1977, after 30 min of pumping.

WELL NO. 2, LABORATORY NO. B52254

	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.3	Silica	SiO ₂	9.2
Manganese	Mn	0.01	Fluoride	F	3.0
Ammonium	NH ₄	1.1	Boron	B	1.7
Sodium	Na	550	Nitrate	NO ₃	0.0
Potassium	K	8.9	Chloride	Cl	420
Calcium	Ca	12	Sulfate	SO ₄	9
Magnesium	Mg	5	Alkalinity (as CaCO ₃)		681
Arsenic	As	0.00			13.62
Barium	Ba	0.0			
Copper	Cu	0.01	Hardness (as CaCO ₃)	27	0.54
Cadmium	Cd	0.00			
Chromium	Cr	0.00	Total dissolved		
Lead	Pb	0.01	minerals	1490	
Mercury	Hg	0.0002			
Nickel	Ni	0.0			
Selenium	Se	0.00			
Silver	Ag	0.00			
Cyanide	CN	0.00			
Zinc	Zn	0.1	pH (as rec'd)	7.9	

WELL NO. 3, open to the Devonian limestone, was completed in May 1971 to a depth of 695 ft by Adolphson Well Drilling, Aledo. This well serves only a supper club and one residence. The well is located approximately 952 ft S and 80 ft W of the NE corner of Section 20, T8N, R1W. The land surface elevation at the well is approximately 660 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Yellow clay	35	35
Blue clay	53	88
Shale with strips of sandrock	70	158
Soft lime	10	168
Hard lime	17	185
Soft lime with some shale	35	220
Medium lime	100	320
Shale	265	585
Gray lime	40	625
Brown lime	15	640
Gray lime	52	692
Shale	3	695

The well is cased with 8-in. pipe from land surface to a depth of 173 ft and 6-in. pipe from 78 ft to a depth of 605 ft. The hole was finished 6 in. in diameter at the bottom.

Upon completion, the well reportedly produced 25 gpm for 2 hr with a drawdown of 195 ft from a nonpumping water level of 133 ft below land surface.

The pumping equipment presently installed is a Red Jacket submersible pump set at 360 ft, rated at 28 gpm, and powered by an electric motor.

WELL NO. 4, open to the Devonian limestone, was completed in 1974 to a depth of 723 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located on the west side of the subdivision north of the lake on lot 441, approximately 2600 ft N and 2300 ft W of the SE corner of Section 19, T8N, R1W. The land surface elevation at the well is approximately 700 ft.

A drillers log of Well No. 4 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil and clay	74	74
Fine muddy sand	65	139
Brown lime	17	156
Shale and lime	60	216
Lime (Burlington)	166	382
Shale (Kinderhook)	248	630
Lime (Devonian)	93	723

The well is cased with 7-in. steel pipe from 2 ft above land surface to a depth of 140 ft and 5-in. PVC pipe from 18 ft to a depth of 637 ft.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 30 gpm, and powered by an electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B18216) is for a water sample from the well collected October 25, 1977, after 30 min of pumping.

WELL NO. 4, LABORATORY NO. B18216

		mg/l	me/l		mg/l	me/l
Iron	Fe	0.1		Silica	SiO ₂	9.2
Manganese	Mn	0.02		Fluoride	F	3.4 0.18
Ammonium	NH ₄	0.5	0.03	Boron	B	1.6
Sodium	Na	270	11.74	Nitrate	NO ₃	0.0 0.00
Potassium	K	4	0.10	Chloride	Cl	56 1.58
Calcium	Ca	2	0.10	Sulfate	SO ₄	32 0.67
Magnesium	Mg	1	0.08	Alkalinity(as CaCO ₃)		483 9.66
Arsenic	As	0.00				
Barium	Ba	0.1				
Copper	Cu	0.02		Hardness (as CaCO ₃)		7 0.14
Cadmium	Cd	0.00				
Chromium	Cr	0.00				
Lead	Pb	0.00		Total dissolved		
Mercury	Hg	0.0000		minerals		678
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.00				
Zinc	Zn	0.0		pH (as rec'd)		9.0

WELL NO. 5, open to the Devonian limestone, was completed in 1974 to a depth of 685 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located on the west side of the subdivision north of the lake on lot 482, approximately 1800 ft N and 1200 ft E of the SW corner of Section 19, T8N, R1W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 5 follows:

Strata	Thickness (ft)	Depth (ft)
Top soil and yellow clay	70	70
Gray sandy mud	62	132
Shale	27	159
Shale and lime	131	290
Lime	90	380
Shale	218	598
Lime	87	685

A 6-in. diameter hole was drilled to a depth of 685 ft. The well is cased with 6-in. steel pipe from 2 ft above land surface to a depth of 135 ft and 5-in. PVC pipe from 16 ft to a depth of 600 ft.

A production test was conducted by the State Water Survey on September 8, 1976. After 2 hr of pumping at rates ranging from 16 to 20 gpm, the final drawdown was 92.15 ft from a nonpumping water level of 162.35 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 171.28 ft. On the basis of the production test data, it was estimated that this well should yield 55 gpm (79,200 gpd) on a long-term basis.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 30 gpm, and powered by an electric motor.

LITTLE YORK

The village of Little York (297) installed a public water supply in 1915. One well (No. 3) is in use and another well (No. 1) is available for emergency use. In 1953 there were 90 services; the average daily pumpage was 20,000 to 25,000 gpd. In 1977 there were 165 services, 3 metered; the estimated average and maximum daily pumpages were 35,600 and 55,000 gpd, respectively. The water is chlorinated.

WELL NO. 1, open to the Devonian limestone and the Silurian dolomite, was completed in 1915 to a depth of 326 ft by W. Van Tuyl. This well is available for emergency use. The well is located approximately 260 ft N and 230 ft E of the SW corner of Section 21, T12N, R3W. The land surface elevation at the well is approximately 623 ft.

A correlated drillers log of Well No. 1 furnished by the State Geological Survey follows:

Strata	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
Clay and dirt	66	66
MISSISSIPPIAN SYSTEM		
Kinderhook Series		
Shale	78	144
Soapstone	56	200
DEVONIAN AND SILURIAN SYSTEMS		
Limestone	126	326

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. A2153) is for a water sample from the well collected July 27, 1977, after 2.5 hr of pumping at 22 gpm.

WELL NO. 1, LABORATORY NO. A2153						
		mg/l	me/l		mg/l	me/l
Iron	Fe	2.23		Silica	SiO ₂	11
Manganese	Mn	0.04		Fluoride	F	0.2 0.01
Ammonium	NH ₄	4.88	0.27	Boron	B	0.4
Sodium	Na	55.0	2.39	Nitrate	NO ₃	0.0 0.00
Potassium	K	3.8	0.10	Chloride	Cl	1 0.03
Calcium	Ca	95.0	4.74	Sulfate	SO ₄	0
Magnesium	Mg	31.6	2.60	Alkalinity(as CaCO ₃)		496 9.92
Arsenic	As	0.004				
Barium	Ba	0.4		Hardness (as CaCO ₃)		370 7.40
Copper	Cu	0.04				
Cadmium	Cd	0.00				
Chromium	Cr	0.00		Total dissolved		
				minerals		490
Lead	Pb	0.00				
Mercury	Hg	0.0002				
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.005				
Zinc	Zn	0.1		pH (as rec'd)		8.3

A 6-in. diameter hole was drilled to a depth of 326 ft. The well is cased with 6-in. black iron pipe from above the floor of a well pit to a depth of 326 ft.

Nonpumping water levels were reported to be 60 ft below land surface in 1915; 45 ft in 1922; 48 ft below land surface in April 1938; and 60 ft below land surface on October 21, 1946.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 30 gpm, and powered by an electric motor.

WELL NO. 2 was completed in 1933 to a depth of 142 ft. This well was abandoned prior to 1971. The well is located about 10 ft north of Well No. 1, approximately 270 ft N and 230 ft E of the SW corner of Section 21, T12N, R3W. The land surface elevation at the well is approximately 623 ft.

The well is cased with 6-in. pipe from above the floor of a well pit to a depth of 135 ft and 4-in. pipe from 135 ft to a depth of 138 ft followed by 4 ft of 3-in. screen.

In 1938, the nonpumping water level was reported to be 48 ft.

A mineral analysis of a sample (Lab. No. 83974) collected July 28, 1938, showed the water to have a hardness of 383 mg/l, total dissolved minerals of 532 mg/l, and an iron content of 2.8 mg/l.

WELL NO. 3, open to the Devonian limestone, Silurian dolomite, and the Galena-Platteville dolomite, was completed in July 1969 to a depth of 872 ft by the Wehling Well Works, Beecher. The well is located in the new village hall building about 5 blocks west of the elevated tank, approximately 330 ft N and 1800 ft W of the SE corner of Section 20, T12N, R3W. The land surface elevation at the well is approximately 623 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Mud	40	40
Gravel	5	45
Sand	20	65
Shale	5	70
Conglomerate	15	85
Lime	17	102
Gray shale	31	133
Broken lime	1	134
Shale	69	203
Lime	187	390
Shale	135	525
Lime	40	565

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Shale	15	580
Lime	241	821
Blue shale	15	836
Gray lime	9	845
Brown lime	14	859
Lime	13	872

A 14-in. diameter hole was drilled to a depth of 165 ft, reduced to 10 in. between 165 and 223 ft, reduced to 8 in. between 223 and 544 ft, and finished 6 in. in diameter from 544 to 872 ft. The well is cased with 10-in. pipe from land surface to a depth of 165 ft, 8-in. pipe from land surface to a depth of 223 ft (cemented in), and a 6-in. liner from 380 ft to a depth of 544 ft.

A production test was conducted by the driller on July 29, 1969. After 3.5 hr of pumping at rates ranging from 125 to 162 gpm, the final drawdown was 82 ft from a nonpumping water level of 107 ft. Three min after pumping was stopped, full recovery was observed.

The pumping equipment presently installed is a Red Jacket submersible pump rated at about 95 gpm, and powered by an electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B118039) is for a water sample from the well collected December 17, 1974, after 2 hr of pumping at 80 gpm.

WELL NO. 3, LABORATORY NO. B118039						
	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>	
Iron	Fe	0.2	Silica	SiO ₂	9	
Manganese	Mn	0.0	Fluoride	F	2.8	0.15
Ammonium	NH ₄	1.7	Boron	B	1.3	
Sodium	Na	316	Nitrate	NO ₃	0.0	0.00
Potassium	K	15.0	Chloride	Cl	164	4.62
Calcium	Ca	79	Sulfate	SO ₄	555	11.54
Magnesium	Mg	37	Alkalinity(as CaCO ₃)	233	4.66	
Arsenic	As	0.00	Hardness (as CaCO ₃)	349	6.98	
Barium	Ba	0.0	Total dissolved			
Copper	Cu	0.00	minerals	1387		
Cadmium	Cd	0.00	pH (as rec'd)	7.7		
Chromium	Cr	0.00	Radioactivity			
Lead	Pb	0.00	Alpha <i>pc/l</i>	17.6		
Mercury	Hg	0.0004	± deviation	8.1		
Nickel	Ni	0.0	Beta <i>pc/l</i>	19.5		
Selenium	Se	0.00	± deviation	5.5		
Silver	Ag	0.00				
Cyanide	CN	0.00				
Zinc	Zn	0.0				

MONMOUTH

The city of Monmouth (11,022) installed a public water supply in 1886. Five wells (Nos. 4, 5, 6, 7, and 8) are in use. In 1949 there were 2900 services, 90 percent metered; the average and maximum daily pumpages were 600,000 and 850,000 gpd, respectively. In 1977 there were 4500 services, all metered; the average and maximum daily pumpages were 2,300,000 and 2,700,000 gpd, respectively. The water is chlorinated and treated with polyphosphate to keep iron in solution; in addition, water from Well Nos. 6, 7, and 8 is aerated for hydrogen sulfide removal.

WELL NO. 1, open to the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone, was completed in 1886 to a depth of 1232 ft. This well was abandoned in 1925 and sealed prior to 1967. The well was located at the corner of East Clinton and North Sixth Sts. at 410 North Sixth St., approximately 2000 ft S and 2602 ft E of the NW corner of Section 29, T11N, R2W. The land surface elevation at the well is approximately 740 ft.

A summary and interpretation of a sample study log of Well No. 1 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Soil and glacial drift	53	53
PENNSYLVANIAN SYSTEM		
Abbott Formation		
Shale, gray, coal seams, pyritic	16	69
MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Burlington-Keokuk Limestone	91	160
Krnderhookian Series		
New Albany Shale Group (base at 405 ft)		
Hannibal Shale, gray, calcareous	129	289
DEVONIAN SYSTEM		
Upper Devonian Shale Series		
Shale, gray to brown	116	405
Base of New Albany Group		405
SILURIAN-DEVONIAN SYSTEMS		
Hunton Megagroup		
Limestone, light brownish gray to gray	120	525
ORDOVICIAN SYSTEM		
Maquoketa Shale Group		
Shale, gray to dark brownish gray; dolomite in middle, dolomitic lower part	240	765
Galena-Platteville Groups		
Dolomite, light brownish gray	309	1074
Ancell Group		
Glenwood-St. Peter Sandstone		
Sandstone, fine to medium, rounded, shaly lower 5 ft	156	1230
Prairie du Chien Group		
Shakopee Dolomite	2	1232

The well was cased with 9-in. pipe from land surface to a depth of 70.5 ft, 6-in. pipe from 70.5 ft to a depth of 147 ft, and 5-in. pipe from 147 ft to a depth of 893 ft.

Nonpumping water levels were reported to be 60 ft below land surface in 1896, 85 ft below land surface in 1912, and 169.7 ft on May 12, 1921.

WELL NO. 2, open to the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone, was completed in

1891 to a depth of 1222 ft. This well was abandoned in 1925 and sealed prior to 1967. The well was located about 32 ft south and 28 ft east of Well No. 1, approximately 2032 ft S and 2630 ft E of the NW corner of Section 29, T11N, R2W. The land surface elevation at the well is approximately 740 ft.

Originally, the well was cased with 10-in. pipe to a depth of 418 ft. In 1923, the well was recased with 6-in. pipe to a depth of about 600 ft.

In 1912, the nonpumping water level was reported to be 85 ft.

WELL NO. 3, open to the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone, was completed in 1899 to a depth of 1222 ft. This well was abandoned in 1925 and sealed prior to 1967. The well was located about 112 ft south and 160 ft east of Well No. 2, approximately 2144 ft S and 2790 ft E of the NW corner of Section 29, T11N, R2W. The land surface elevation at the well is approximately 740 ft.

Originally, the well was cased with 8-in. pipe to a depth of 402 ft. About 1915, the well was recased by sealing a 6-in. water discharge pipe, 678 ft long, to the surrounding rock.

WELL NO. 4, open to the Cambrian-Ordovician aquifer, was completed in 1924 to a depth of 2445 ft by the S. B. Geiger & Co., Chicago. This well is alternated with Well No. 5. The well is located in the main pumping station at the intersection of South A St. and the "Q" RR tracks, approximately 25 ft N and 245 ft E of the SW corner of Section 29, T11N, R2W. The land surface elevation at the well is approximately 767 ft.

A sample study log of Well No. 4 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Drift	95	95
PENNSYLVANIAN SYSTEM		
Abbott Formation		
Coal	1	96
Shale	14	110
MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Burlington Limestone		
Limestone, slightly dolomitic, cherty, slightly fossiliferous	80	190
Kinderhookian Series		
New Albany Group (base at 465 ft)		
Hannibal Shale		
Shale, gray to black	90	280
DEVONIAN SYSTEM		
Upper Devonian Shale Series		
Shale, brown to greenish gray to light gray to black	185	465
Base of New Albany Group		465
Middle Devonian Series		
Cedar Valley-Wapsipinicon Limestone		
Limestone, buff, slightly dolomitic, slightly fossiliferous	95	560
SILURIAN SYSTEM		
Dolomite, light gray, slightly cherty	40	600

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale, brown to brownish gray, slightly dolomitic to dolomitic	190	790
Galena-Platteville Dolomite Groups		
Dolomite, light brownish gray to light brown, some cherty zones, fine to sublithographic	320	1110
Ancell Group		
Glenwood-St. Peter Sandstone		
Sandstone, white, fine to medium, rounded and frosted grains, incoherent; mixture of sand, clay, and chert at base	165	1275
Prairie du Chien Group		
Shakopee Dolomite		
Dolomite, sandy, light gray, cherty (some oolitic)	275	1550
New Richmond Sandstone		
Sandstone, white, medium	5	1555
Oneota Dolomite		
Dolomite, light gray, cherty, medium crystalline	245	1800
Gunter Sandstone		
Sandstone, light pinkish gray, medium, dolomitic	30	1830
CAMBRIAN SYSTEM		
Croixan Series		
Eminence-Potosi Dolomite		
Dolomite, light gray to light pinkish gray, slightly sandy, very fine crystalline, glauconitic near base	260	2090
Franconia Formation		
Sandstone, light gray to greenish gray, dolomitic, glauconitic	235	2325
Ironton-Galesville Sandstone		
Sandstone, white to light gray, coarse glauconite at top, incoherent to cemented	120	2445

The well is cased with 24-in. pipe from 0.2 ft above the bottom of a 6-ft deep pit to a depth of 85 ft, 18-in. cast iron pipe from 2 ft above the bottom of a 6-ft deep pit to a depth of 488 ft, and 14-in. OD copperoid pipe from 488 ft to a depth of 1050 ft. Below the casing, the hole was finished 12 in. in diameter to the bottom.

Nonpumping water levels were reported to be 183 ft in April 1925, 201 ft in August 1932, 212.5 ft in October 1939, 220 ft in 1942, 229 ft in March 1943, 224 ft below the pump base in February 1944, and 234 ft in 1949.

In 1954, after pumping at a rate of 800 gpm, the drawdown was 30 ft from a nonpumping water level of 255 ft.

In January 1955, the nonpumping water level was reported to be 258 ft.

In August 1956, the well reportedly produced 1000 gpm for 5 hr with a drawdown of 28 ft from a nonpumping water level of 254 ft.

On August 12, 1957, after 1 hr of pumping at a rate of 1100 gpm, the drawdown was 29 ft from a nonpumping water level of 258 ft.

In 1959, the well reportedly produced 1100 gpm for 1 hr with a drawdown of 28 ft from a nonpumping water level of 254 ft.

The pumping equipment presently installed consists of a 100-hp Fairbanks-Morse electric motor, a 12-in., 7-stage

Fairbanks-Morse submersible pump (Serial No. PT1421) set at 362 ft, rated at 1000 gpm at about 305 ft head, and has 362 ft of 8-in. column pipe. The well is equipped with 362 ft of airline.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B51855) of a sample collected June 23, 1977, after pumping for 45 min at 1000 gpm, showed the water to have a hardness of 277 mg/l, total dissolved minerals of 1080 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 5, open to the Cambrian-Ordovician aquifer, was completed in 1925 to a depth of 2445 ft by the S. B. Geiger & Co., Chicago. This well is alternated with Well No. 4. The well is located in the main pumping station about 30 ft east of Well No. 4, approximately 25 ft N and 275 ft E of the SW corner of Section 29, T11N, R2W. The land surface elevation at the well is 768.6 ft.

A sample study log of Well No. 5 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
RECENT AND PLEISTOCENE SERIES		
Drift	95	95
PENNSYLVANIAN SYSTEM		
Abbott Formation		
Coal	1	96
Shale	14	110
MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Burlington Limestone		
Limestone, gray, soft	80	190
Kinderhookian Series		
New Albany Group (base at 475 ft)		
Hannibal Shale		
Shale, gray, soft	20	210
Shale, blue	30	240
Shale, hard, gray	10	250
Shale, blue, soft	30	280
DEVONIAN SYSTEM		
Upper Devonian Shale Series		
Sweetland Creek Shale		
Shale, gray, hard	20	300
Shale, dark gray, soft	30	330
Shale, brown, soft	30	360
Shale, blue, soft	80	440
Shale, gray, hard	10	450
Shale, blue, hard	5	455
Shale, hard, and limestone	20	475
Base of New Albany Group		475
Middle Devonian Series		
Cedar Valley and Wapsipinicon Limestones		
Limestone, brown, hard	95	570
SILURIAN SYSTEM		
Niagaran Series		
Limestone, light gray, hard	10	580
Limestone, gray and brown	30	610
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale, light colored, soft	45	655
Shale, dark, hard	35	690
Limestone, dark, hard	78	768
Limestone and shale, hard	12	780
Galena Group		
Limestone, brown, hard	218	998
Limestone, gray, hard	41	1039
Shale, soft	3	1042
Platteville Group		
Limestone, brown, hard	58	1100
Ancell Group		
St. Peter Sandstone		

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sandstone, dark gray, hard	70	1170
Sandstone, white, soft	75	1245
Sandstone, white, hard	5	1250
Shale, blue, soft	4	1254
Limestone, shaly, and sandstone; hard	6	1260
Shale, green, soft	5	1265
Shale, sandy, soft	10	1275
Prairie du Chien Group		
Limestone, brown, and gray, hard	175	1450
Limestone, pink, hard	50	1500
Limestone, brown and gray, hard	50	1550
Sandstone, white, soft	5	1555
ORDOVICIAN-CAMBRIAN SYSTEMS (undifferentiated)		
No record	110	1665
Lime, brown and gray, hard	10	1675
Lime, gray, hard	50	1725
Lime, brown, hard	50	1775
Lime, brown and gray, hard, crevicy	5	1780
Lime, gray and brown, hard	95	1875
Lime, brown, hard	20	1895
Lime, brown and gray, hard	20	1915
Lime, gray, hard	20	1935
Lime, brown, hard	20	1955
Lime, gray, hard	20	1975
Lime, brown, hard	90	2065
Lime, gray, hard	30	2095
CAMBRIAN SYSTEM		
Franconia Formation		
Lime, gray, soft	130	2225
Lime, gray, hard	70	2295
Sandstone, gray, hard	35	2330
Ironton-Galesville Sandstone		
Sand, white, soft	43	2373
Sand, white, hard	5	2378
Sand, white, soft	32	2410
Sand, white, shelly	23	2433
Sand, dark, shelly	12	2445

The well is cased with 24-in. drive pipe from 0.2 ft above the bottom of a 6-ft deep pit to a depth of 85 ft, 19-in. OD cast iron pipe from 2.5 ft above the bottom of a 6-ft deep pit to a depth of 485 ft, 14-in. OD pipe from 443.5 ft to a depth of 1044 ft, and a 10-in. ID liner from 1225 ft to a depth of 1285 ft. Below the casing, the hole was finished 8 in. in diameter to the bottom.

Nonpumping water levels were reported to be 183 ft in April 1925; 201 ft in August 1932; 212.5 ft in October 1939; 222.5 ft in March 1943; 224 ft in February 1944; 246 ft on January 29, 1946; and 234 ft in 1949.

In January 1955, after pumping at a rate of 1150 gpm, the drawdown was 40 ft from a nonpumping water level of 258 ft.

In August 1956, the well reportedly produced 1100 gpm for 10 hr with a drawdown of 32 ft from a nonpumping water level of 254 ft below the top of the casing.

On August 12, 1957, after 1 hr of pumping at a rate of 1100 gpm, the drawdown was 28 ft from a nonpumping water level of 258 ft.

In 1959, the well reportedly produced 1100 gpm for 1 hr with a drawdown of 32 ft from a nonpumping water level of 254 ft.

The pumping equipment presently installed consists of a 100-hp 1750 rpm General Electric motor, a Haywood Tyler submersible pump set at 358 ft, rated at 1000 gpm at about

305 ft head, and has 358 ft of 8-in. column pipe. The well is equipped with 358 ft of airline.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. A113334) of a sample collected March 26, 1974, after pumping for 1 hr at 1000 gpm, showed the water to have a hardness of 237 mg/l, total dissolved minerals of 978 mg/l, and an iron content of 0.25 mg/l.

WELL NO. 6, open to the Cambrian-Ordovician aquifer, was completed in December 1954 to a depth of 2465 ft by the Varner Well and Pump Co., Dubuque, Iowa. The well is located near the intersection of North Fifth St. and East Girard Ave. in a pumphouse near the elevated tank, approximately 300 ft S and 1200 ft E of the NW corner of Section 29, T11N, R2W. The land surface elevation at the well is approximately 745 ft.

An interpreted drillers log of Well No. 6 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Drift, yellow clay and fine gravel	56	56
PENNSYLVANIAN SYSTEM		
Coal and shale, gray to black	36	92
MISSISSIPPIAN SYSTEM		
Lime, gray	11	103
Lime, cherty	86	189
MISSISSIPPIAN-DEVONIAN SYSTEMS		
New Albany Group		
Shale, gray to green, some sticky	276	465
DEVONIAN SYSTEM		
Limestone, gray, hard	108	573
SILURIAN SYSTEM		
Niagaran Series		
Dolomite, some shale and iron	27	600
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale and lime, some hard dolomite, gray to grayish brown	195	795
Galena-Platteville Groups		
Dolomite, some chert, gray to brownish gray	300	1095
Ancell Group		
Glenwood-St. Peter Sandstone		
Sandstone, mostly white, little shale and lime	190	1285
ORDOVICIAN-CAMBRIAN SYSTEMS (undifferentiated)		
Knox Megagroup		
Dolomite, some chert, little sand, gray to brown	815	2100
CAMBRIAN SYSTEM		
Franconia Formation		
Sandstone, fine, calcareous, shaly, glauconitic	229	2329
Ironton-Galesville Sandstone		
Sandstone, white, fine to medium, friable	136	2465

A 20-in. diameter hole was drilled to a depth of 174 ft, reduced to 18 in. between 174 and 835 ft, reduced to 17 in. between 835 and 1285 ft, reduced to 15 in. between 1285 and 1390 ft, and finished 13 in. in diameter from 1390 to 2465 ft. The well is cased with 18-in. OD pipe from land surface to a depth of 835 ft (cemented in to 174 ft), 16-in. OD liner pipe from 1206 ft to a depth of 1285 ft, and 14-in. liner pipe from 1269 ft to a depth of 1390 ft.

A production test was conducted on December 16-17, 1954,

by representatives of the driller, the city, the State Water Survey, and Missman, Stanley, Farmer & Associates, Consulting Engineers. After 24 hr of pumping at rates ranging from 1022 to 1110 gpm, the final drawdown was 45 ft from a nonpumping water level of 242 ft below land surface. Fifteen min after pumping was stopped, the water level had recovered to 245 ft.

In December 1955, the well reportedly produced 1170 gpm with a drawdown of 37 ft from a nonpumping water level of 244 ft.

In August 1956, after pumping at a rate of 1150 gpm, the drawdown was 37 ft from a nonpumping water level of 243 ft.

On August 12, 1957, the well reportedly produced 1100 gpm for 1 hr with a drawdown of 30 ft from a nonpumping water level of 245 ft.

In 1959, after 1 hr of pumping at a rate of 1100 gpm, the drawdown was 37 ft from a nonpumping water level of 243 ft.

The pumping equipment presently installed consists of a 100-hp 1750 rpm Fairbanks-Morse electric motor, a 12-in., 7-stage Fairbanks-Morse submersible turbine pump (Serial No. PT1419) set at 362 ft, rated at 1000 gpm at about 305 ft head, and has 362 ft of 8-in. column pipe. The well is equipped with 362 ft of airline.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B52799) of a sample collected June 28, 1977, after pumping for 45 min at 1000 gpm, showed the water to have a hardness of 314 mg/l, total dissolved minerals of 1200 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 7, open to the Cambrian-Ordovician aquifer except for the Glenwood-St. Peter Sandstone, was completed in November 1965 to a depth of 2448 ft by the Wehling Well Works, Beecher. The well is located on West Harlem Ave. just west of the North Line of the "Q" RR tracks, approximately 203 ft N and 276 ft W of the SE corner of Section 19, T11N, R2W. The land surface elevation at the well is approximately 758 ft.

A drillers log of Well No. 7 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Soil	5	5
Clay	73	78
Mud	12	90
Lime	80	170
Lime and shale	20	190
Gray shale	33	223
Shale	27	250
Gray shale	210	460
Shale	5	465
Lime	140	605
Lime and shale	6	611
Shale	29	640
Shale and lime	10	650
Shale	32	682
Shale and lime	22	704
Shale	2	706
Lime and shale	76	782
Shale	8	790
Lime	244	1034

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Shale	3	1037
Lime	54	1091
Sand	67	1158
Shale	4	1162
Sand, lime and shale	35	1197
Sand	32	1229
Shale	14	1243
Shale, gypsum and lime	6	1249
Lime	336	1585
Sand	5	1590
Lime	243	1833
Sand	23	1856
Lime	241	2097
Shale and lime	94	2191
Lime	62	2253
Lime and shale	53	2306
Sand	139	2445
Shale	3	2448

A 30-in. diameter hole was drilled to a depth of 98 ft, reduced to 29 in. between 98 and 465 ft, reduced to 23 in. between 465 and 1100 ft, reduced to 19 in. between 1100 and 1260 ft, and finished 15 in. in diameter from 1260 to 2448 ft. The well is cased with 30-in. drive pipe from land surface to a depth of 98 ft, 24-in. pipe from land surface to a depth of 467 ft, 20-in. pipe from land surface to a depth of 814 ft (cemented in), and a 16-in. liner from 1139 ft to a depth of 1260 ft.

A production test was conducted by the driller on November 17-18, 1965. After 20.2 hr of pumping at rates of 930 to 1000 gpm, the final drawdown was 184 ft from a nonpumping water level of 244 ft below land surface.

In 1974, this well was shot with nitroglycerin by the Winslow Well Drilling Co., Walcott, Iowa. A production test was then conducted on July 11, 1974. After pumping at a rate of 1073 gpm, the drawdown was 49 ft from a nonpumping water level of 264 ft below land surface.

The pumping equipment presently installed is a Fairbanks-Morse pump set at 372 ft, rated at 1000 gpm, and powered by a 100-hp General Electric motor.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B117078) of a sample collected December 11, 1974, after pumping for 40 min at 1000 gpm, showed the water to have a hardness of 317 mg/l, total dissolved minerals of 1283 mg/l, and an iron content of 0.2 mg/l. Hydrogen sulfide was apparent when a previous sample was collected.

WELL NO. 8, open to the Cambrian-Ordovician aquifer except for the Glenwood-St. Peter Sandstone, was completed in August 1974 to a depth of 2460 ft by the Wehling Well Works, Beecher. The well is located northwest of South Fifth St. and East Seventh Ave., approximately 710 ft S and 3270 ft W of the NE corner of Section 32, T11N, R2W. The land surface elevation at the well is approximately 765 ft.

A drillers log of Well No. 8 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Drift	54	54

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Clay - sandstone	71	125
Lime	220	345
Shale	175	520
Lime	35	555
Lime with shale	170	725
Shale and lime	160	885
Lime and sandy lime	95	980
Dolomite	145	1125
Sand with dolomite	110	1235
St. Peter	40	1275
Lime	115	1390
Lime with shale	75	1465
Dolomite and shale	175	1640
Trempealeau	90	1730
Dolomite	150	1880
Sand - lime	40	1920
Lime	85	2005
Lime - sand	70	2075
Lime	185	2260
Lime with sand	78	2338
Sand	122	2460

A 30-in. diameter hole was drilled to a depth of 80 ft, reduced to 20 in. between 80 and 814 ft, reduced to 19 in. between 814 and 1 310 ft, and finished 15 in. in diameter from 1310 to 2460 ft. The well is cased with 30-in. black steel pipe from land surface to a depth of 80 ft, 20-in. black steel pipe from about 2 ft above land surface to a depth of 814 ft (cemented in to 80 ft), and a 16-in. black steel liner from 1076 ft to a depth of 1310 ft.

A production test was conducted by the driller on August 21-22, 1974. After 24 hr of pumping at rates ranging

from 816 to 1542 gpm, the final drawdown was 28 ft from a nonpumping water level of 268 ft. Fifteen min after pumping was stopped, the water level had recovered to 271 ft.

The pumping equipment presently installed is a Johnston submersible turbine pump set at 357 ft, rated at 1000 gpm at about 300 ft TDH, and powered by a 100-hp General Electric motor.

The following mineral analysis (Lab. No. 196930) is for a water sample from the well collected during the initial production test, after 24 hr of pumping at rates of 816 to 1542 gpm.

WELL NO. 8, LABORATORY NO. 196930					
		<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i> <i>me/l</i>
Iron(total)	Fe	0.1		Silica	SiO ₂ 11.3
Manganese	Mn	0.00		Fluoride	F 1.7
Ammonium	NH ₄	Tr	Tr	Boron	B 0.8
Sodium	Na	247	10.74	Nitrate	NO ₃ 5.6 0.09
Potassium	K	16.0	0.41	Chloride	Cl 116 3.27
Calcium	Ca	64.0	3.19	Sulfate	SO ₄ 418.8 8.71
Magnesium	Mg	28.3	2.33	Alkalinity(as CaCO ₃)	222 4.44
Strontium	Sr	2.36	0.05	Hardness (as CaCO ₃)	276 5.52
Barium	Ba	<0.1			
Copper	Cu	0.00		Total dissolved	
				minerals	1032
Cadmium	Cd	0.00			
Chromium	Cr	0.00			
Lead	Pb	<0.05			
Lithium	Li	0.16		Turbidity	2
Nickel	Ni	<0.05		Color	0
Zinc	Zn	0.03		Odor	0

ROSEVILLE

The village of Roseville (1111) installed a public water supply in 1895. One well (No. 9) is in use. In 1950 there were 343 services; the average and maximum daily pumpages were 50,000 and 60,000 gpd, respectively. In 1975 there were 550 services, all metered; the average and maximum daily pumpages were 140,000 and 185,000 gpd, respectively. The water is chlorinated and fluoridated.

Initially, water was obtained from a 50-ft deep well, which penetrated an abandoned coal mine. The well was cased with 12-in. iron pipe to a depth of 50 ft. In November 1914, the nonpumping water level was reported to be 18 ft below land surface. After 1902, this well was rented by the Central Illinois Public Service Co. and the village used it only in case of an emergency. This well was abandoned prior to 1927.

A well, finished in sandstone, was completed in 1902 to a depth of 1350 ft (reported in 1923 to be filled below a depth of 600 ft) by the J. P. Miller Artesian Well Co., Brookfield. This well was abandoned prior to 1927. The well was located about 20 ft from the mine shaft near the center of the village. The well was cased with 6-in. pipe to a depth of 500 ft. In 1923, the nonpumping water level was reported to be 140 ft.

A well, finished in sand and gravel, was completed in 1925 to a depth of 38 ft by the Layne-Bowler Co., Chicago. This well was abandoned in 1931. The well was located about 0.5 mile west of the village. The well was cased with 10-in. pipe to an unknown depth.

A well, finished in sand and gravel, was completed in 1925 to a depth of 40 ft by the Layne-Bowler Co., Chicago. This well was abandoned in 1931. The well was located about 150 ft west of the third well. The well was cased with 10-in. pipe to an unknown depth.

A dug well was constructed in 1930 to a depth of 15 ft. This well was abandoned prior to 1946. The well was located about 860 ft west of the village limits. A 4-ft diameter hole was dug to a depth of 15 ft. The well was constructed by sinking a steel caisson to a depth of about 15 ft and laying brick in a 4-ft diameter circular well within the caisson, using no mortar in the joints, after which the space between the well and the caisson was filled with gravel and the caisson withdrawn. A quantity of crushed stone was placed at the bottom of the well to prevent entrance of sand from the formation below. In 1933, after pumping at a rate of about 35 gpm, the drawdown was 9.0 ft from a nonpumping water

level of 2.8 ft below the top of the well curb.

WELL NO. 1, finished in sand and gravel, was completed in January 1934 to a depth of about 34 ft (measured in 1946 to be 25 ft deep) by the W. L. Thorne Co., Des Plaines. This well is not in use and has been disconnected from the system. The well is located about 0.5 mile west of the village, approximately 210 ft S and 900 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

A sample study log of Well No. 1 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Illinoian Formation		
Soil, silty, brown, noncalcareous	3	3
Gumbo sand, brown and brownish-gray, fine to coarse, noncalcareous	2	5
Sand and silt, brownish-gray, fine to coarse, noncalcareous	2	7
Sand, grayish-brown, medium to coarse, noncalcareous, clean	5	12
Sand, grayish-brown, coarse to very coarse, noncalcareous, clean	7	19
Sand, grayish-brown, medium to very coarse, noncalcareous, clean	4	23
Yarmouth Formation		
Silt, sandy, brownish-gray, micaceous, much organic material, noncalcareous	3	26
Soil, silty, sandy, brown to black, noncalcareous, iron cemented	2	28
Silt and clay, slightly sandy, brownish-gray, micaceous, carbonaceous flakes, slightly calcareous	3	31

The well is cased with 30-in. outer pipe from land surface to an unknown depth and 16-in. inner pipe from 2.3 ft above land surface to a depth of 19 ft followed by 15 ft of 16-in. No. 250 slot screen. The annulus between the bore hole and casing-screen assembly is filled with gravel.

A production test was conducted on August 15, 1946, by representatives of the village, C. W. Varner, and the State Water Survey. At 7:00 a.m., the nonpumping water level was reported to be 4.0 ft below the top of the casing. Well Nos. 1 and 2 were pumped to the distribution system for approximately 2 hr prior to pumping only Well No. 1 for 1.1 hr at rates of 32 to 33 gpm. The pumping water level was then reported to be 19.7 ft below the top of the casing. Thirty-nine min after pumping was stopped, the water level had recovered to 4.9 ft.

A partial analysis of a sample (Lab. No. 107560) collected August 15, 1946, showed the water to have a hardness of 177 mg/l, total dissolved minerals of 215 mg/l, and an iron content of 1.2 mg/l.

WELL NO. 2, finished in sand and gravel, was completed in 1936 to a depth of 19 ft (sounded in 1946 to be 14.2 ft deep) by the W. L. Thorne Co., Des Plaines. This well was abandoned and sealed prior to July 1975. The well was located about 65 ft northwest of Well No. 1, approximately

185 ft S and 960 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

The well was cased with 30-in. outer pipe from 2 ft above land surface to a depth of 14 ft and 16-in. inner pipe from about 1 ft above land surface to a depth of 7 ft followed by 12 ft of 16-in. No. 250 slot screen. The annulus between the bore hole and casing-screen assembly was filled with gravel to 19 ft. In 1952 during rehabilitation, a 6-in. casing was inserted followed by 6 ft of 6-in. No. 30 slot Johnson screen from 13 ft to a depth of 19 ft. The annulus between the 16-in. casing-screen assembly and the 6-in. casing-screen assembly was filled with selected gravel.

A production test was conducted by the State Water Survey on July 23-24, 1936. After 24 hr of pumping at rates ranging from 36 to 41 gpm, the final drawdown was 13.1 ft from a nonpumping water level of 1.7 ft below land surface. At rates above 40 gpm, the well reportedly yielded fine sand.

A production test was conducted on August 15, 1946, by representatives of the village, C. W. Varner, and the State Water Survey. After 3.8 hr of pumping at rates ranging from 25.5 to 23 gpm, the pumping water level was 9.8 ft below the top of the casing. Ten min after pumping was stopped, the water level had recovered to 4.1 ft. During this test, Well No. 1 was operating intermittently. The nonpumping water level in Well No. 2 was 2.2 ft below the top of the casing prior to the production test of Well No. 1.

In April 1952, this well was rehabilitated by Rowland & Sons, Rushville. A new 6-in. casing and screen was installed and the well was repacked with gravel. The well then reportedly produced 30 to 25 gpm for 1.8 hr with a final drawdown of 10.8 ft from a nonpumping water level of 6.9 ft below the top of the casing.

A partial analysis of a sample (Lab. No. 107561) collected August 15, 1946, showed the water to have a hardness of 203 mg/l, total dissolved minerals of 268 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 3, finished in sand and gravel, was completed in August 1946 to a depth of 23.3 ft by the Varner Well and Pump Co., Dubuque, Iowa. This well was abandoned and sealed prior to July 1975. The well was located about 55 ft north of Well No. 1 and 60 ft east of Well No. 2, approximately 180 ft S and 900 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Surface drift	10	10
Sand	13	23
Clay	1	24

The well was cased with 20-in. OD pipe from 4 ft above land surface to a depth of 11.3 ft and 12-in. ID pipe from

4 ft above land surface to a depth of 11.3 ft followed by 12 ft of 12-in. No. 30 slot Johnson screen. The annulus between the bore hole and casing-screen assembly was filled with 28 cubic feet of washed gravel.

A production test was conducted on August 14, 1946, by representatives of the village, the driller, and the State Water Survey. After pumping at rates ranging from 35 to 39 gpm, the pumping water level was 19.3 ft below land surface. Twelve min after pumping was stopped, the water level had recovered to 5.8 ft. Well Nos. 1 and 2 were idle during the last 1.8 hr of this test. On August 15, the non-pumping water level in Well No. 3 was 0.2 ft below land surface.

On June 10, 1952, after 5 hr of pumping at an unknown rate, the pumping water level was reported to be 16.75 ft below the top of the casing. Thirty min after pumping was stopped, the water level had recovered to 6.50 ft.

A mineral analysis of a sample (Lab. No. 1075 59) collected August 15, 1946, after pumping for 7 hr at 35 gpm, showed the water to have a hardness of 148 mg/l, total dissolved minerals of 235 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 4, finished in sand and gravel, was completed in 1957 to a depth of 27 ft. This well was abandoned and sealed prior to July 1975. The well was located about 50 ft south of Well No. 2, approximately 235 ft S and 980 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

The well was cased with 42-in. pipe from land surface to a depth of 18 ft and 10-in. pipe from above land surface to a depth of 21 ft followed by 6 ft of 10-in. No. 30 slot screen. The annulus between the bore hole and casing-screen assembly was filled with gravel.

Two 8-in. diameter test holes were constructed in May 1962 to depths of 36 and 41 ft by the Layne-Western Co., Aurora. These holes were located in the northeast quarter of Section 36, T9N, R3W.

WELL NO. 5, finished in sand and gravel, was completed in September 1962 to a depth of 23 ft by the Layne-Western Co., Aurora. This well was abandoned and sealed prior to July 1975. The well was located about 155 ft northeast of Well No. 3, approximately 75 ft S and 800 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 726 ft.

A drillers log of Well No. 5 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Black top soil	1	1
Wet black dirt, peat	9.5	10.5
Fine to medium sand	9	19.5
Brown saturated fine to medium sand with silt seams	3.5	23

A 38-in. diameter hole was drilled to a depth of 12 ft and finished 30 in. in diameter from 12 to 23 ft. The well was

cased with 12-in. pipe from 2 ft above land surface to a depth of 13 ft followed by 10 ft of 12-in. No. 30 slot silicon bronze screen. The annulus between the bore hole and casing-screen assembly was filled with gravel.

A production test was conducted on September 24, 1962, by representatives of the driller, the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 3.7 hr of pumping at a rate of 30 gpm, the drawdown was 10.79 ft from a nonpumping water level of 3.69 ft below land surface.

A partial analysis of a sample (Lab. No. 157657) collected during the initial production test, after pumping for 3 hr at 30 gpm, showed the water to have a hardness of 122 mg/l, total dissolved minerals of 227 mg/l, and an iron content of 0.7 mg/l.

WELL NO. 6, finished in sand and gravel, was completed in March 1965 to a depth of 23.5 ft by the Layne-Western Co., Aurora. This well was abandoned and sealed prior to July 1975. The well was located about 90 ft south of Well No. 5, approximately 160 ft S and 800 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 6 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Black top soil	4	4
Peat	1.5	5.5
Soft blue clay	0.5	6
Medium brown sand	11.5	17.5
Medium gray sand	3	20.5
Silty gray clay	1	21.5
Medium gray sand, with gray balls (bottom sand loose)	3	24.5

A 38-in. diameter hole was drilled to a depth of 12 ft and finished 30 in. in diameter from 12 to 23.5 ft. The well was cased with 17.8 ft of 10-in. steel pipe and equipped with 8 ft of 10-in. No. 30 slot Cook bronze screen. The annulus between the bore hole and casing-screen assembly was filled with cement from 0 to 12 ft and with 5 yards of No. 0 gravel from 12 to 23.5 ft.

Upon completion, the well reportedly produced 50.8 gpm for 6 hr with a drawdown of 8.6 ft from a nonpumping water level of 8.4 ft.

WELL NO. 7, finished in sand and gravel, was completed in April 1968 to a depth of 24 ft by the Layne-Western Co., Aurora. This well was abandoned and sealed prior to July 1975. The well was located about 75 ft southeast of Well No. 6, approximately 220 ft S and 740 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 7 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Black soil	2	2
Brown clay	1	3

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Dirty sand	2	5
Gray fine sand	20	25

A 34-in. diameter hole was drilled to a depth of 10 ft and finished 30 in. in diameter from 10 to 24 ft. The well was cased with 10-in. steel pipe from 4 ft above land surface to a depth of 16 ft followed by 8 ft of 10-in. No. 30 slot Cook bronze screen. The annulus between the bore hole and casing-screen assembly was filled with cement from 0 to 10 ft, with fine sand from 10 to 12 ft, and with 4 yards of No. 0 Northern gravel from 12 to 24 ft.

A production test was conducted by the driller on April 23, 1968. After 4 hr of pumping at a rate of 37.5 gpm, the drawdown was 7 ft from a nonpumping water level of 9 ft below land surface. Pumping was continued for 2 hr at a rate of 30 gpm with a final drawdown of 5 ft.

A partial analysis of a sample (Lab. No. 174677) collected during the initial production test, after pumping for 6 hr at 30 gpm, showed the water to have a hardness of 180 mg/l, total dissolved minerals of 234 mg/l, and an iron content of 0.0 mg/l.

WELL NO. 8, finished in sand and gravel, was completed in April 1968 to a depth of 24 ft by the Layne-Western Co., Aurora. This well was abandoned and sealed prior to July 1975. The well was located about 110 ft west of Well No. 7, approximately 250 ft S and 830 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 8 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Black soil	3	3
Brown clay	1	4
Very tough gray clay	8	12
Fine dirty sand	13	25

A 34-in. diameter hole was drilled to a depth of 10 ft and finished 30 in. in diameter from 10 to 24 ft. The well was cased with 10-in. steel pipe from 4 ft above land surface to a depth of 16 ft followed by 8 ft of 10-in. No. 30 slot Cook bronze screen. The annulus between the bore hole and casing-screen assembly was filled with cement from 0 to 10 ft, with fine sand from 10 to 12 ft, and with 4 yards of No. 0 Northern gravel from 12 to 24 ft.

A production test was conducted by the driller on April 24, 1968. After 6 hr of pumping at a rate of 30 gpm, the drawdown was 8 ft from a nonpumping water level of 9 ft below land surface.

A partial analysis of a sample (Lab. No. 174710) collected during the initial production test, after pumping for 6 hr at

30 gpm, showed the water to have a hardness of 238 mg/l, total dissolved minerals of 275 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 9 (horizontal collector), finished in sand and gravel, was constructed in 1970 and extended in 1972. The collector extends west-southwest from the well field beginning at a 4-ft diameter caisson located about 110 ft south of Well No. 3, approximately 290 ft S and 920 ft W of the NE corner of Section 36, T9N, R3W. The land surface elevation at the collector ranges from approximately 725 ft at the beginning to about 738 ft at the end.

The horizontal collector begins at a 4-ft diameter concrete caisson extending from 6.6 ft above original land surface to a depth of 14.5 ft. One horizontal lateral projects from the caisson at a depth of about 6 ft and extends west-southwest along a streambed about 1528 ft. The original lateral consists of 128 ft of 4-in. diameter cast iron pipe and 600 ft of 12-in. diameter perforated asbestos cement pipe. In 1972 the lateral was extended 800 ft with 12-in. diameter perforated PVC pipe. The lateral was placed in a bed of washed pea gravel in a 3-ft wide trench excavated into the top of the aquifer. In addition to the beginning caisson there are 5 additional access caissons 48 and 42 in. in diameter located 28, 418, 818, 1228, and 1528 ft from the first.

The pumping equipment is installed in the beginning caisson and consists of two Red Jacket submersible pumps, each rated at 145 gpm, and powered by 10-hp electric motors.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B51512) is for a water sample from the well collected June 21, 1977, after 1 hr of pumping at 100 gpm.

WELL NO. 9, LABORATORY NO. B51512									
		<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>			
Iron	Fe	0.0		Silica	SiO ₂	22			
Manganese	Mn	0.00		Fluoride	F	0.2	0.01		
Ammonium	NH ₄	0.04	0.00	Boron	B	0.1			
Sodium	Na	12	0.52	Nitrate	NO ₃	29	0.47		
Potassium	K	0.7	0.02	Chloride	Cl	15	0.42		
Calcium	Ca	42	2.10	Sulfate	SO ₄	56	1.16		
Magnesium	Mg	20	1.65	Alkalinity (as CaCO ₃)		100	2.00		
Arsenic	As	0.00							
Barium	Ba	0.0							
Copper	Cu	0.02		Hardness (as CaCO ₃)		179	3.58		
Cadmium	Cd	0.00							
Chromium	Cr	0.00							
Lead	Pb	0.01		Total dissolved minerals		241			
Mercury	Hg	0.0000							
Nickel	Ni	0.0							
Selenium	Se	0.00							
Silver	Ag	0.00							
Cyanide	CN	0.00							
Zinc	Zn	0.0		pH (as rec'd)		6.9			