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*Public Groundwater Supplies
in Putnam County*

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PUBLIC GROUNDWATER SUPPLIES IN PUTNAM COUNTY

by Dorothy M. Woller and Ellis W. Sanderson

Introduction

This publication presents all available information on production wells used for public groundwater supplies in Putnam 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 groundwater supplies of 6 municipalities, 1 public water district, and 1 subdivision in Putnam County. These are preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for municipal 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 John B. Stall, Head of the Hydrology Section. Mrs. J. L. Ivens and Mrs. P. A. Motherway edited the manuscript, Mrs. Suzi O'Connor typed the camera-copy, and John W. Brothier, Jr., prepared 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. M. L. Sargent of the Illinois State Geological Survey prepared the generalized column of rock stratigraphic units and aquifers. R. D. Brower, Assistant Geologist, Illinois State Geological Survey, and M. L. Sargent 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.

Geology

The geology of Putnam County is described generally in Illinois State Geological Survey Circular 248, *Groundwater Geology in East-Central Illinois*. The following brief discussion of geologic conditions in the county is taken largely from this publication. For a more detailed definition of the geology in this portion of the state, the reader is referred to the State Geological Survey which is located on the University of Illinois campus, Urbana.

The unconsolidated materials forming the present day land surface in Putnam County vary greatly in thickness and water-yielding character. Extensive deposits of sand and gravel suitable for developing large municipal and industrial groundwater supplies are associated with the Illinois River

valley and the partially buried preglacial valley of the ancient Mississippi River. Sand and gravel deposits also are associated with the buried Ticona bedrock valley in the northeastern part of the county. The unconsolidated materials are thinner and contain less continuous sand and gravel deposits in the eastern part of the county in the bedrock upland area.

The uppermost bedrock beneath the glacial deposits dips east-southeasterly at a rate of about 15 to 30 ft per mile. The bedrock units considered in this report range in age from Pennsylvanian to Ordovician (see generalized stratigraphic sequence in figure 1).

The uppermost bedrock throughout the county is of Pennsylvanian age and consists mostly of shale, coal, and some thin

SYSTEM	SERIES	GROUP OR FORMATION	AQUIFER	LOG	THICKNESS (FT)	GENERALIZED DESCRIPTION
QUATERNARY	PLEISTOCENE		Sands and Gravels		0-350	Till, gravel, sand, silt, peat, loess
PENNSYLVANIAN					150-525	Shale, sandstone, clay, limestone, coal
DEVONIAN	MIDDLE	Cedar Valley—Wapsipinicon			0-100	Limestone and dolomite, silty, cherty, fine gray to buff, part slightly pyritic
SILURIAN	NIAGARAN	Racine—Marcus	Silurian		200-475	Dolomite, crystalline, vesicular, white to gray, partly cherty
	ALEXANDRIAN				50-75	Dolomite, dense to vesicular, silty and sandy in lower part
ORDOVICIAN	CINCINNATIAN	Maquoketa			145-200	Shale, dolomitic, green to gray, some dolomite
	CHAMPLAINIAN	Galena	Galena—Platteville		210-230	Dolomite and limestone, medium-grained, cherty in lower part
		Platteville			130-165	Dolomite, fine-grained, cherty
		Glenwood—St. Peter	Glenwood—St. Peter		120-170	Sandstone, medium-grained, friable, mostly white

Figure 1. Generalized geologic column of rock formations in Putnam County
(Prepared by M. L. Sargent, Illinois State Geological Survey)

interbedded layers of sandstone and limestone. These rocks range in thickness from about 150 ft in the western part to more than 525 ft along the eastern margin of the county. The Pennsylvanian rocks are not considered to offer potential as a source for municipal or subdivision water supplies. However, in the bedrock upland areas, farm and domestic water supplies are obtained locally from sandstone and creviced limestone units in the upper 250 ft of these rocks.

Beneath the Pennsylvanian rocks in the western part of the county lie Devonian age rocks which consist of limestones and dolomites. These rocks lie at depths ranging from about 400 ft on the upland in the western part of the county to about 450 ft beneath the lowlands near the east bluff of the Illinois River valley. They range in thickness from about 100 ft along the west edge of the county thinning to a feather-edge below the east bluff of the valley. The yield capability of the Devonian rocks is generally small and depends pri-

marily upon the number, size, and degree of interconnection of water-filled cracks and crevices penetrated by a well bore.

The Silurian dolomite lies below the Pennsylvanian and Devonian rocks. This dolomite is encountered at depths from about 450 ft in the west to 700 ft in the southeast. It ranges in thickness from about 550 ft in the central and southeast to less than 500 ft in the west and northeast. In the extreme northeast part erosion has decreased the Silurian thickness to about 250 ft. Water in moderate quantities may be obtained from the cracks and crevices of the Silurian rocks, but it is too highly mineralized for most uses.

The Maquoketa Group of Ordovician age is composed primarily of nonwater-bearing shales that separate the Silurian rocks from deeper water-bearing units. These shales lie at depths from less than 1000 ft in the northwest to about 1200 ft in the southern part of the county. They range in thickness from about 145 to 200 ft.

Below the Maquoketa Group occurs a thick sequence of hydrologically connected aquifers of Ordovician age. They consist in downward order of the Galena-Platteville Dolomite Groups, Glenwood-St. Peter Sandstone, Shakopee Dolomite, New Richmond Sandstone, and Oneota Dolomite. Water supply wells in Putnam County have not penetrated below the Glenwood-St. Peter Sandstone.

The Galena-Platteville Dolomite lies at depths from about 1150 ft in the northwest to about 1400 ft in the southeast part of the county. It ranges in thickness from 340 ft to about 400 ft. Water from this unit is also obtained from

cracks and crevices intersected by the well bore. No municipal wells tap only this aquifer even though moderate quantities of water (50 to 100 gpm) may be available. The water probably would be moderately mineralized. Usually, wells are also open to the deeper Glenwood-St. Peter Sandstone.

The Glenwood-St. Peter Sandstone lies below the Galena-Platteville at depths from about 1450 ft in the west to about 1750 ft in the southeast part of the county. It ranges in thickness from about 120 to 170 ft. The Glenwood-St. Peter is one of the more reliable aquifers of the Ordovician sequence and is capable of yielding moderate quantities of water. The water is moderately mineralized.

Groundwater Development for Municipal Use

Groundwater is used as a source for 6 groundwater supply systems serving Granville, Hennepin, Hennepin Public Water District, Lake Thunderbird Subdivision, McNabb, Magnolia, Mark, and Standard. The locations of these supplies are shown in figure 2.

Unconsolidated sand and gravel deposits associated with the Illinois River valley and the ancient Mississippi valley are tapped as a source of water by the wells at the Hennepin Public Water District, Lake Thunderbird Subdivision, McNabb, and Magnolia. There are presently 7 supply wells finished in these aquifers at depths of 100 to 237 ft. Their reported yields range from 15 to 780 gpm depending primarily upon the type of well constructed and the permeability, thickness, and areal extent of the sand and gravel unit tapped by each well. Analyses of water from these wells indicate that the iron content ranges from 0.0 to 7.6 mg/1, and the hardness from 296 to 379 mg/1. Water for Magnolia is chlorinated. Water for Lake Thunderbird Subdivision and McNabb is chlorinated and fluoridated. Water for the Hennepin Public Water District is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution.

Magnolia Well No. 1 penetrates the Pennsylvanian rocks. It is 320 ft deep and is pumped at a rate of 15 gpm. A recent analysis of water from this well indicates the iron content is 0.42 mg/1 and the hardness is 326 mg/1.

The deep-lying Galena-Platteville Dolomite and Glenwood-St. Peter Sandstone are tapped as a source of water for Granville and Standard. Three wells are in use and range in depth from 1741.6 to 1793 ft. They are pumped at rates of about 60 to 150 gpm. Analyses of water from the Granville wells show the iron content ranges from 0.1 to 1.7 mg/1, chlorides from 240 to 500 mg/1, sodium from 245 to 316 mg/1, hardness from 212 to 296 mg/1, and total dissolved minerals from 975 to 1164 mg/1. At Standard, the most recent analysis shows the iron content to be 3.8 mg/1, chlorides of 3690 mg/1, sodium of 2550 mg/1, hardness of 238 mg/1, and

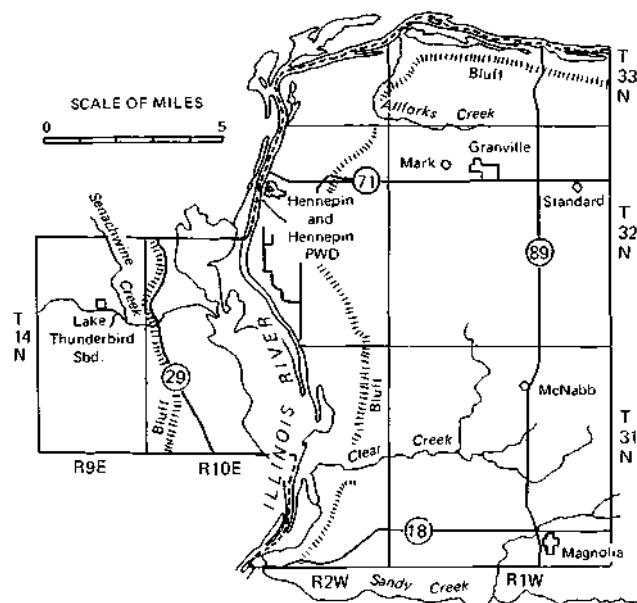


Figure 2. Location of public groundwater supplies in Putnam County

total dissolved minerals of 6333 mg/1. Available information suggests that a large portion of the water pumped from the Standard well is from overlying units known to yield highly mineralized water. The water for Granville is chlorinated and polyphosphate is added to keep iron in solution. Water for Standard is not treated. The natural fluoride content of water from these wells satisfies present standards.

Total municipal supply pumpage in Putnam County for 1974 was about 317,500 gpd. Estimated pumpage from wells tapping sand and gravel aquifers was about 52 percent of this total (164,000 gpd) and the remaining 48 percent (153,500 gpd) was pumped from wells finished in the underlying bedrock units.

Format

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

The U.S. Census of population for 1970 for incorporated places is given at the beginning of each description. 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 calciferous rocks which in most of Illinois are dolomitic in composition. When stating the bedrock aquifers tapped by a well, the sample study log by the Geological Survey and the 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 determined readily, then the principal rock type usually is given (i.e., dolomite).

The screen sizes given in this publication are for continuous slot type screens unless stated otherwise. Slot sizes given indicate the width of the slot openings in thousands 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. Approximate equivalent slot openings for other types of screens are given in parentheses after the screen designation.

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
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

GRANVILLE

The village of Granville (1232) installed a public water supply in 1911. One well (No. 2) is in use and another well (No. 1) is available for emergency use. This supply also serves the village of Mark (379). In 1950 there were 300 services in Granville; the average and maximum daily pump-ages (including the village of Mark) were 65,000 and 133,000 gpd, respectively. In 1974 there were 557 services in Granville, 96 percent metered; the average and maximum daily pumpages (including the village of Mark) were 145,000 and 186,000 gpd, respectively. The water is chlorinated and treated with polyphosphate to keep iron in solution. The natural fluoride concentration in the water is adequate to satisfy state requirements.

WELL NO. 1, open to the Galena-Platteville Dolomite and Glenwood-St. Peter Sandstone, was completed in 1911 to a depth of 1741.6 ft by the J. P. Miller Artesian Well Co., Brookfield. This well is available for emergency use. The well is located on lot 1, block 15 at Main and Lake Sts., approximately 730 ft S and 2400 ft W of the NE corner of Section 9, T32N, R1W. The land surface elevation at the well is approximately 690 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Drift	129	129
Shale and coal	716	845
Limestone	245	1090
Shale	174	1264
Limestone	373	1637
St. Peter sandstone	90	1727
Limestone	14	1741

The well is cased with 10-in. pipe from land surface to a depth of 130 ft, 8-in. pipe from land surface to a depth of 345 ft, 6-in. pipe from 334 ft to a depth of 578 ft, 5-in. pipe from 572 ft to a depth of 1192 ft, and 4.2-in. pipe from 1192 ft to a depth of 1316.5 ft. Packers were placed between the 8-in. and 6-in. casings, and between the 6- and 5-in. casings, and the 4.2-in. casing was belled out against the 5-in. casing. The hole was finished 4.2 in. in diameter from 1316.5 to 1741.6 ft.

Nonpumping water levels were reported as follows: 125 ft in 1915 and 1918, 167.5 ft on January 8, 1946, and 217 ft on May 9, 1974.

The pumping equipment presently installed is a submersible turbine pump set at 420 ft, rated at 92.5 gpm, and powered by a 15-hp 3450 rpm Franklin electric motor.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B0024118) of a sample collected June 15, 1972, after pumping for 12 hr at 95 gpm, showed the water to have a hardness of 240 mg/l, total dissolved minerals of 1020 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 2, open to the Galena-Platteville Dolomite and Glenwood-St. Peter Sandstone, was completed in November 1948 to a depth of 1793 ft by Neely and Schimel-

pfenig, Batavia. The well is located in the southeast part of the village, approximately 2225 ft S and 400 ft W of the NE corner of Section 9, T32N, R1W. The land surface elevation at the well is approximately 680 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 SYSTEM		
"Black soil, yellow and gray clay"	90	90
"Hardpan with gravel"	75	165
Sand and gravel, silty	15	180
Till, gravelly at base	50	230
Sand and gravel	10	240
PENNSYLVANIAN SYSTEM		
Shale; coal; underclay	30	270
Siltstone	15	285
Shale; coal; underclay	30	315
Limestone, dolomitic	10	325
Siltstone	45	370
Shale; coal; underclay	55	425
Siltstone; limestone	15	440
Shale; limestone; sandstone	140	580
SILURIAN SYSTEM		
Niagaran Series		
Dolomite, silty, shale streaks	110	690
Shale, dolomitic, silty	15	705
Dolomite, silty, shale streaks	325	1030
Dolomite	22	1052
Alexandrian Series		
Kankakee Formation		
Dolomite, cherty	35	1087
Edgewood Formation		
Siltstone, glauconitic	16	1103
ORDOVICIAN SYSTEM		
Maquoketa Formation		
Shale, dolomitic	62	1165
Dolomite, argillaceous	20	1185
Shale, dolomitic	65	1250
Dolomite, argillaceous	10	1260
Galena Formation		
Dolomite	160	1420
Dolomite, cherty, argillaceous	120	1540
Decorah Formation		
Dolomite	30	1570
Platteville Formation		
Dolomite, cherty at base	65	1635
St. Peter Formation		
Sandstone	157	1792
Conglomerate, shale, and chert	1	1793

An 18-in. diameter hole was drilled to a depth of 279 ft, reduced to 17 in. between 279 and 548 ft, reduced to 13 in. between 548 and 1140 ft, reduced to 10 in. between 1140 and 1298 ft, and finished 8 in. in diameter from 1298 to 1793 ft. The well is cased with 18-in. drive pipe from land surface to a depth of 279 ft and 8-in. pipe from 1.5 ft above land surface to a depth of 1297.5 ft (cemented in).

A production test was conducted on December 14-15, 1948, by representatives of the driller, the State Water Survey, and Francis Engineering Company, Consulting Engineers. After 1.5 hr of pumping at rates of 96 to 99 gpm, the drawdown was 22.5 ft from a nonpumping water level of 170.0 ft below land surface. Pumping was continued for 2.2 hr at a rate of 150 gpm with a drawdown of 41.0 ft.

After an additional 7.2 hr at rates ranging from 198.5 to 236 gpm, the final drawdown was 88.5 ft. Ten min after pumping was stopped, the water level had recovered to 170.5 ft.

The pumping equipment presently installed is an 8-in., 18-stage Aurora Line-Shaft turbine pump (Model No. DWT, Serial No. 42799) set at 350 ft, rated at 200 gpm at about 400 ft TDH, and powered by a 30-hp 1800 rpm U.S. electric motor (Model No. CFU).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B0024119) is for a water sample from the well collected June 15, 1972, after 2 hr of pumping at 230 gpm.

WELL NO. 2, LABORATORY NO. B0024119

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.2	0.01	Silica	SiO ₂	9.8	
Manganese	Mn	0.0		Fluoride	F	1.5	0.08
Ammonium	NH ₄	1.8	0.10	Boron	B	0.7	
Sodium	Na	280	12.18	Nitrate	NO ₃	0.0	
Potassium	K	9.8	0.25	Chloride	Cl	240	8.18
Calcium	Ca	52.0	2.60	Sulfate	SO ₄	168	3.49
Magnesium	Mg	23	1.89	Alkalinity(asCaCO ₃)		264	5.28
				Hardness (asCaCO ₃)		224	
Barium	Ba	0.0		Total dissolved			
Copper	Cu	0.02		minerals		1014	
Cadmium	Cd	0.00		pH (asrec'd)	7.9		
Chromium	Cr	0.0		Radioactivity			
Lead	Pb	0.00		Alpha pc/l	14.6		
Mercury	Hg	< 0.0005		^deviation	6.2		
Nickel	Ni	0.0		Beta pc/l	16.0		
Silver	Ag	0.0		±deviation	4.6		
Zinc	Zn	0.0					

HENNEPIN

The village of Hennepin (535) installed a public water supply in 1875. Finished water for this supply is obtained from the Hennepin Public Water District (*see Hennepin Public Water District*). In 1951 there were 22 services and in 1965, just prior to the formation of the Water District, there were 135 services.

HENNEPIN PUBLIC WATER DISTRICT

The Hennepin Public Water District (est. 650), serving the village of Hennepin and the Jones & Laughlin Steel Corporation, installed a public water supply in 1966. Three wells (Nos. 3, 4, and 5) are in use. Well Nos. 3 and 4 were formerly owned by the village of Hennepin. In 1973 there were approximately 205 services, 4 percent metered; the average and maximum daily pumpages were 120,000 and 189,000 gpd, respectively. The water is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution.

WELL NO. 1, finished in Silurian dolomite, was constructed for the village of Hennepin in 1875 to a depth of 800 ft, and reportedly deepened in 1910 to a depth of 850 ft by Winfield Hall. This well was abandoned and sealed about 1952. The well was located near the center of the public square in Hennepin, approximately 1 350 ft N and 1600 ft W of the SE corner of Section 9, T32N, R2W. The land surface elevation at the well is approximately 503 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 SYSTEM		
Soil	3	3
Gravel	62	65
Conglomerate	8	73

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sand, gravel at base	39	112
Clay	63	175
Sand and gravel	25	200
Clay	30	230
PENNSYLVANIAN SYSTEM		
Shale	130	360
Sand	40	400
SILURIAN SYSTEM		
Niaganan Series		
Limestone and sandstone (probably all limestone)	100	500
Limestone	350	850

Originally, a 4-in. diameter hole was drilled to a depth of 800 ft and cased with 4-in. pipe to a depth of 400 ft. After deepening, the well was cased with 4-in. pipe from land surface to a depth of 480 ft.

In 1875, the artesian pressure was reported to be about 28 lb (or 65 ft of water). The flow was estimated at 80 gpm. The artesian pressure by 1910 had decreased to about 18 lb (or 41.5 ft of water).

In 1939, this well was cleaned and recased by Chris Ebert, Washington. The rate of flow was reported to be 20 gpm after this work.

A mineral analysis of a sample (Lab. No. 109926) collected April 13, 1947, showed the water to have a hardness of 63 mg/l, total dissolved minerals of 2865 mg/l, and an iron content of 2.0 mg/l.

A well, finished in sand, was completed in May 1941 to a depth of 100 ft by Schwiderski & Son. This well was abandoned and sealed in 1950. The well was located in the east part of Hennepin, approximately 630 ft N and 470 ft E of the SW corner of Section 10, T32N, R2W. The well was cased with 4-in. pipe to a depth of 95 ft followed by 5 ft of 2-in. No. 60 slot Clayton Mark screen. Upon completion, the nonpumping water level was reported to be 78 ft below land surface.

WELL NO. 2, finished in sand and gravel, was completed for the village of Hennepin in January 1951 to a depth of 115 ft by J. Bolliger & Sons, Fairbury. This well was abandoned and sealed in 1958. The well was located in the pump-house at the east edge of Hennepin, approximately 685 ft N and 460 ft E of the SW corner of Section 10, T32N, R2W. The land surface elevation at the well is approximately 520 ft.

A drillers log of Well No. 2 follows:

Strata	Thickness (ft)	Depth (ft)
Clay	1	1
Clay and gravel	3	4
Sand, coarse (yellow) —dry	71	75
Sand and gravel, coarse (reddish)	30	105
Sand, coarse (gray)	10	115

An 8-in. diameter hole was drilled to a depth of 115 ft. The well was cased with 8-in. pipe from 2 ft above land surface to a depth of 110 ft followed by 5 ft (6 ft overall length) of 4-in. No. 40 slot Johnson Everdur screen.

A production test was conducted on January 24, 1951, by representatives of the driller, the village of Hennepin, the State Water Survey, and Crenshaw & Jost, Consulting Engineers. After 3.2 hr of pumping at rates of 116 to 127 gpm, the drawdown was 17.0 ft from a nonpumping water level of 75.3 ft below land surface. After an additional 10 min of pumping at a rate of approximately 250 gpm, the final drawdown was 33.7 ft. Two min after pumping was stopped, the water level had recovered to 75.4 ft.

In 1954, this well was treated with Calgon to remove iron clogging the screen. This same procedure was repeated several times before final abandonment of the well.

A partial analysis of a sample (Lab. No. 138206) collected July 17, 1955, showed the water to have a hardness of 296 mg/l, total dissolved minerals of 362 mg/l, and an iron content of 0.9 mg/l.

WELL NO. 3, finished in sand and gravel, was completed for the village of Hennepin in November 1955 to a depth of 100 ft by the Layne-Western Co., Aurora. This well is now operated by the Water District. The well is located on the north side of High St. between Third and Fourth Sts., approximately 1200 ft N and 1600 ft W of the SE corner of Section 9, T32N, R2W. The land surface elevation at the well is approximately 503 ft.

A 26-in. diameter hole was drilled to a depth of 100 ft. The well is cased with 26-in. OD pipe from 2.5 ft above land

surface to a depth of 90 ft and 8-in. ID pipe from 68 ft to a depth of 90 ft followed by 10 ft of 8-in. Layne stainless steel shutter screen. The annulus between the 26- and 8-in. casings and between the bore hole and screen is filled with 1/4 to 1/8-in. gravel from 68 to 100 ft.

A production test was conducted on November 28, 1955, by representatives of the driller, the village of Hennepin, the State Water Survey, and Crenshaw & Jost, Consulting Engineers. After 8 hr of pumping at rates of 144 to 160 gpm, the drawdown was 1.53 ft from a nonpumping water level of 60.72 ft below the top of the casing. Ten min after pumping was stopped, the water level had recovered to 60.73 ft.

A production test was conducted by the driller on October 12, 1967. After pumping at a rate of 425 gpm, the drawdown was 21 ft from a nonpumping water level of 58 ft.

On June 12, 1969, the driller reported that the well produced 380 gpm with a drawdown of 13 ft from a nonpumping water level of 59 ft.

The pumping equipment presently installed is a Layne & Bowler oil-lubricated Line-Shaft turbine pump (No. 60858) set at about 85 ft, rated at 400 gpm at about 287 ft head, and powered by a 40-hp 1800 rpm U.S. electric motor (Type RU, Serial No. MR1009055).

A drillers log of Well No. 3 follows:

Strata	Thickness (ft)	Depth (ft)
Black top soil	2	2
Yellow gravelly clay	3	5
Coarse gravel	20	25
Yellow clay and gravel, mixed	9	34
Dirty yellow clay	11	45
Medium gravel, dry	25	70
Medium clean gravel	29	99
Shale, blue	1	100

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B105799) is for a water sample from the well collected January 2, 1974, after 1.5 hr of pumping at 310 gpm.

WELL NO. 3, LABORATORY NO. B105799

	mg/l	me/l	mg/l	me/l
Iron	Fe 0.03	Silica	SiO ₂ 17	
Manganese	Mn 0.11	Fluoride	F 0.4	0.02
Ammonium	NH ₄ 0.0	Boron	B 0.1	
Sodium	Na 18	Nitrate	NO ₃ 22	0.35
Potassium	K 1.7	Chloride	Cl 12	0.34
Calcium	Ca 79	Sulfate	SO ₄ 66	1.37
Magnesium	Mg 37	Alkalinity(as CaCO ₃)	280	5.60
Arsenic	As 0.00			
Barium	Ba 0.2	Hardness (as CaCO ₃)	349	6.98
Copper	Cu 0.00			
Cadmium	Cd 0.00	Total dissolved minerals	435	
Chromium	Cr 0.00			
Lead	Pb 0.00			
Mercury	Hg 0.0000	pH (as rec'd)	8.1	
Nickel	Ni 0.0	Radioactivity		
Selenium	Se 0.00	Alpha <i>pci</i>	1.4	
Silver	Ag 0.00	±deviation	1.7	
Cyanide	CN 0.00	Beta <i>pci</i>	2.2	
Zinc	Zn 0.03	±deviation	1.4	

WELL NO. 4, finished in sand and gravel, was completed for the village of Hennepin in September 1959 to a depth of 107 ft by the Layne-Western Co., Aurora. This well is now operated by the Water District. The well is located on the east side of Fifth St. between Sycamore and Market Sts., approximately 400 ft N and 1300 ft W of the SE corner of Section 9, T32N, R2W. The land surface elevation at the well is approximately 505 ft. .

A drillers log of Well No. 4 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	2.5	2.5
Dirty sand and gravel	5.5	8
Coarse sand and gravel	10	18
Coarse sand and gravel with streaks of clay	8	26
Coarse sand and gravel	81	107

A 20-in. diameter hole was drilled to a depth of 107 ft. The well is cased with 20-in. pipe from 2 ft above land surface to a depth of 97 ft and an 8-in. pipe from 5 3 ft to a depth of 97 ft followed by 10 ft of 8-in. No. 5 (0.105 in.) Layne stainless steel shutter screen. The annulus between the 20- and 8-in. casings and between the bore hole and screen is filled with 3.5 cubic yards of gravel from 5 3 to 107 ft.

Upon completion, the well reportedly produced from 60 to 80 gpm for 4 hr with little drawdown (probably less than 1 ft) from a nonpumping water level of 68 ft.

A production test was conducted by the driller on October 19, 1967. After pumping at a rate of 388 gpm, the drawdown was 3 ft from a nonpumping water level of 64 ft.

On June 12, 1969, the driller reported that the well produced 380 gpm with a drawdown of 2.5 ft from a nonpumping water level of 63.5 ft.

The pumping equipment presently installed is a Layne & Bowler oil-lubricated Line-Shaft turbine pump (No. 60859) set at about 80 ft, rated at 400 gpm at about 287 ft head, and powered by a 40-hp 1800 rpm U.S. electric motor (Model No. RU, SerialNo.MR100905 3).

A partial analysis of a sample (Lab. No. 150610) collected September 14, 1959, after pumping for 4 hr at 60 gpm, showed the water to have a hardness of 320 mg/l, total dissolved minerals of 393 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 5, finished in sand and gravel, was completed for the Water District in May 1967 to a depth of 135 ft by the J. P. Miller Artesian Well Co., Brookfield. The well is located 0.5 mile north of Hennepin, approximately 140 ft N and 200 ft W of the SE corner of Section 4, T32N, R2W. The land surface elevation at the well is approximately 520 ft.

A drillers log of Well No. 5 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	3	3
Sand and gravel	132	135

A 38-in. diameter hole was drilled to a depth of 135 ft. The well is cased with 30-in. OD pipe from land surface to a depth of 20 ft and 18-in. steel pipe from 2 ft above land surface to a depth of 110 ft followed by 25 ft of 18-in. No. 60 slot Johnson screen. The annulus between the bore hole and 30-in. casing is filled with cement from 0 to 20 ft and the annulus between the 30- and 18-in. casings and between the bore hole and 18-in. casing-screen assembly is filled with cement from 0 to 20 ft, with bentonite and sand from 20 to 78 ft, and with graded silica gravel from 78 to 135 ft.

Upon completion, the well reportedly produced 780 gpm for 24 hr with a drawdown of 8 ft from a nonpumping water level of 55 ft below the top of the casing.

The pumping equipment presently installed is a Layne & Bowler oil-lubricated Line-Shaft turbine pump (No. 56663) set at 100 ft, rated at 600 gpm at about 315 ft head, and powered by a 75-hp 1800 rpm U.S. electric motor (Type JU, Serial No. 1408098).

A partial analysis of a sample (Lab. No. 171626) collected June 9, 1967, after pumping for 24 hr at 780 gpm, showed the water to have a hardness of 296 mg/l, total dissolved minerals of 381 mg/l, and an iron content of 0.1 mg/l.

LAKE THUNDERBIRD SUBDIVISION

Lake Thunderbird Subdivision (est. 475), located 2 miles northwest of Putnam, installed a public water supply in 1971. The water system is owned and operated by the Lake Thunderbird Association. One well is in use. In 1974 there were 148 services, none metered; the average and maximum daily pumpages in 1973 were 24,000 and 30,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1, finished in sand and gravel, was completed in March 1970 to a depth of 102.5 ft by the J. P. Miller Artesian Well Co., Brookfield. The well is located below the dam by the maintenance shop, approximately 200 ft S

and 980 ft W of the NE corner of Section 14, T14N, R9E. The land surface elevation at the well is approximately 520 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	3	3
Sand and gravel	102	105

A 12-in. diameter hole was drilled to a depth of 105 ft. The well is cased with 8-in. pipe from 2 ft above land surface to a depth of 82 ft followed by 20.5 ft of 8-in. No. 30

slot Howco stainless steel screen. The annulus between the bore hole and casing-screen assembly is filled with cement from 0 to 50 ft and with gravel from 50 ft to the bottom.

Upon completion, the well reportedly produced 320 gpm for 8 hr with a drawdown of 13 ft from a nonpumping water level of 31 ft below land surface.

On May 13, 1971, the nonpumping water level was reported to be 35.5 ft.

The pumping equipment presently installed is an 8-in., 12-stage Peerless Line-Shaft turbine pump (Serial No. 224172) set at 65 ft, rated at 300 gpm at about 300 ft TDH, and powered by a 30-hp 1750 rpm U.S. electric motor (Model No. RU, Serial No. R2039283).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B110985) is for a

water sample from the well collected April 22, 1974, after 45 min of pumping at 250 gpm.

WELL NO. 1, LABORATORY NO. B110985

		mg/l	me/l	mg/l	me/l
Iron	Fe	0.02	Silica	SiO ₂	17
Manganese	Mn	0.00	Fluoride	F	0.2 0.01
Ammonium	NH ₄	0.0 0.00	Boron	B	0.1
Sodium	Na	9 0.39	Nitrate	NO ₃	6.2 0.10
Potassium	K	2.2 0.06	Chloride	Cl	5 0.14
Calcium	Ca	86 4.29	Sulfate	SO ₄	61 1.27
Magnesium	Mg	40 3.29	Alkalinity(asCaCO ₃)		312 6.24
Arsenic	As	0.00	Hardness (as CaCO ₃)		379 7.58
Barium	Ba	0.0	Total dissolved		
Copper	Cu	0.02	minerals		444
Cadmium	Cd	0.00	pH (asrec'd)		7.7
Chromium	Cr	0.00	Radioactivity		
Lead	Pb	0.00	Alpha	pc/l	1.1
Mercury	Hg	0.0000	±deviation		1.2
Nickel	Ni	0.0	Beta	pc/l	5.5
Selenium	Se	0.00	±deviation		2.2
Silver	Ag	0.00			
Cyanide	CN	0.00			

Mc NABB

The village of McNabb (246) installed a public water supply in 1934. One well (No. 2) is in use. In 1952 there were 23 services, none metered. In 1974 there were 104 services, 94 percent metered; the average and maximum daily pumpages were 20,000 and 30,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1 (formerly Illinois Emergency Relief Commission well), finished in sand and gravel, was constructed in September 1934 to a depth of 192 ft by Guy L. Kinsey, Wenona, and reportedly deepened in 1950 to a depth of 210 ft by Mr. Packard, Washburn. This well was abandoned in 1968. The well is located on the south side of Main St. east of Theodore St., approximately 70 ft S and 1870 ft W of the NE corner of Section 10, T31N, R1W. The land surface elevation at the well is approximately 688 ft.

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

Strata	Thickness (ft)	Depth (ft)
PLEISTOCENE SYSTEM		
Soil and till	50	.50
Granule gravel, clean	5	55
Till	5	60
Sand, gravelly, clean	10	70
Sand, silty	5	75
"Clay"	111	186
"Sand, loose"	6	192
No record	8	200

Originally, a 6-in. diameter hole was drilled to a depth of 192 ft. The well was equipped with a pitless adapter from 3.5 ft above the pit floor, and cased with 6-in. pipe from 1 ft above the pit floor to a depth of 186 ft followed by 6 ft of 6-in. screen. After deepening, a 4-in. casing was inserted inside the original 6-in. pipe from 1 ft above the pit floor to

an unknown depth. Information on the screen installed after deepening is not available.

In 1934, the well reportedly produced 5 gpm for 1 week with a drawdown of 7 ft from a nonpumping water level of 54 ft.

WELL NO. 2, finished in sand and gravel, was completed in February 1966 to a depth of 237 ft by Albrecht Well Drilling, Inc., Ohio. The well is located about 1000 ft northwest of the elevated tank, approximately 330 ft N and 2260 ft E of the SW corner of Section 3, T31N, R1W. The land surface elevation at the well is approximately 670 ft.

A drillers log of Well No. 2 follows:

Strata	Thickness (ft)	Depth (ft)
Dirt	2	2
Yellow clay	8	10
Gray clay	8	18
Sand	3	21
Gray clay	20	41
Water in sand	4	45
Gray clay	10	55
Light blue clay	3	58
Dry gravel	2	60
Clay	20	80
Clay with sand streaks	5	85
Sand and gravel, water	3	88
Stoney with clay	2	90
Soft clay	90	180
Tough red or brown clay	15	195
Fine sand	3	198
Soft gray clay	2	200
Brown clay with sand streaks	10	210
Very thin clay with sand streaks	7	217
Sand	3	220
Sand and gravel	12	232
Gravel	6	238
Clay or shale (tough)	12	250

A 6-in. diameter hole was drilled to a depth of 250 ft and then backfilled with pea gravel from 237 to 250 ft. The well

is equipped with a Baker pitless adapter from 1 ft above land surface to a depth of 5 ft and cased with 6-in. pipe to a depth of 222.5 ft and equipped with 10 ft of No. 15 slot and 4 ft of No. 40 slot Johnson screen.

Upon completion, the nonpumping water level was reported to be 70 ft.

In 1967, the well reportedly produced 100 gpm with a drawdown of 18 ft from a nonpumping water level of 60 ft.

The pumping equipment presently installed is a 6-in. Goulds submersible turbine pump (Model No. UD66LX32) rated at 100 gpm, and powered by a 10-hp electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B109332) is for a water sample from the well collected April 16, 1973, after

2 hr of pumping at 100 gpm. Methane gas was present in a previous sample.

WELL NO. 2, LABORATORY NO. B109332

		mg/l	me/l		mg/l	me/l
Iron	Fe	2.20	0.08	Silica	SiO ₂	20
Manganese	Mn	0.02	0.00	Fluoride	F	0.30 0.02
Ammonium	NH ₄	6.40	0.35	Boron	B	0.3
Sodium	Na	100	4.35	Nitrate	NO ₃	0.00 0.00
Potassium	K	1.70	0.04	Chloride	Cl	13 0.37
Calcium	Ca	70	3.49	Sulfate	SO ₄	0.00 0.00
Magnesium	Mg	33	2.71	Alkalinity(as CaCO ₃)	504	10.08
Arsenic	As	0.03		Hardness (as CaCO ₃)	310	6.20
Barium	Ba	0.5				
Copper	Cu	0.00		Total dissolved		
Cadmium	Cd	0.00		minerals	603	
Chromium	Cr	0.00				
Lead	Pb	0.00		pH (asrec'd)	7.4	
Mercury	Hg	0.0000		Radioactivity		
Nickel	Ni	0.0		Alpha pc/l	3.2	
Selenium	Se	0.00		±deviation	2.8	
Silver	Ag	0.00		Beta pc/l	8.3	
Zinc	Zn	0.00		±deviation	3.2	

MAGNOLIA

The village of Magnolia (328) installed a public water supply in 1952. Three wells (Nos. 1, 3, and 4) are in use. Although this village is in Putnam County, the new well (No. 4) is located about one-half mile south of the village in Marshall County. In 1951 there were 50 services, none metered. In 1973 there were 105 services, none metered; the average and maximum daily pumpages were 15,000 and 22,000 gpd, respectively. The water is chlorinated.

WELL NO. 1, was constructed in 1951 to a depth of 222 ft by Guy Defenbaugh, Dana, and deepened in 1960 into the Pennsylvanian rocks to a depth of 320 ft. The well is located in the village park about 1 block east of the business district, approximately 2000 ft S and 2000 ft E of the NW corner of Section 35, T31N, R1W. The land surface elevation at the well is approximately 670 ft.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B109535) is for a water sample from the well collected April 23, 1973, after 35 min of pumping at 9 gpm. Methane gas was present in a previous sample.

WELL NO. 1, LABORATORY NO. B109535

		mg/l	me/l		mg/l	me/l
Iron	Fe	0.42	0.02	Silica	SiO ₂	20
Manganese	Mn	0.04	0.00	Fluoride	F	0.3 0.02
Ammonium	NH ₄	11	0.61	Boron	B	0.3
Sodium	Na	78	3.39	Nitrate	NO ₃	0.0 0.00
Potassium	K	2.6	0.07	Chloride	Cl	9 0.25
Calcium	Ca	78	3.89	Sulfate	SO ₄	0.0 0.00
Magnesium	Mg	32	2.63	Alkalinity(as CaCO ₃)	494	9.88
Arsenic	As	0.00		Hardness (as CaCO ₃)	326	6.52
Barium	Ba	0.5				
Copper	Cu	0.01		Total dissolved		
Cadmium	Cd	0.00		minerals	514	
Chromium	Cr	0.00				
Lead	Pb	0.00		pH (asrec'd)	7.7	
Mercury	Hg	0.0000		Radioactivity		
Nickel	Ni	0.0		Alpha pc/l	2.7	
Selenium	Se	0.00		±deviation	2.6	
Silver	Ag	0.00		Beta pc/l	12.0	
Zinc	Zn	0.01		±deviation	3.1	

The well is cased with 8-in. pipe from 1.5 ft above the pumphouse floor to an unknown depth.

The pumping equipment presently installed is a Red Jacket submersible turbine pump rated at 15 gpm, and powered by a 1-hp electric motor.

WELL NO. 2, finished in sand and clay, was completed in September 1960 to a depth of 85 ft by the Germantown Well Drilling Co., Metamora. This well was abandoned in December 1972. The well is located in a field several blocks north of the main part of town on the north side of Iowa St., approximately 700 ft S and 1900 ft E of the NW corner of Section 35, T31N, R1W. The land surface elevation at the well is approximately 665 ft.

A drillers log of Well No. 2 follows:

Strata	Thickness (ft)	Depth (ft)
Top soil	2	2
Yellow clay	17	19
Sand	11	30
Blue clay	55	85

The well is cased with 24-in. ID concrete tile from land surface to a depth of 30 ft and 18-in. ID concrete tile from 30 ft to a depth of 85 ft. The annulus between the bore hole and concrete tile is filled with concrete from 0 to 10 ft and with gravel from 10 to 85 ft.

Upon completion, the well reportedly produced 30 gpm for 2 hr with a drawdown of 45 ft from a nonpumping water level of 25 ft.

Two test holes were drilled in 1962 by Charles M. Hayes, Champaign, in an attempt to develop an additional supply for the village. The first hole was drilled to a depth of 75 ft and located about 0.2 mile northwest of the village in the SE quarter of Section 27, T31N, R1W. The second hole, located about 400 ft southwest of the first hole, approxi-

mately 100 ft S and 1000 ft W of the NE corner of Section 34, T31N, R1W, was developed as a test well. It was finished in sand and gravel to a depth of 54.6 ft. A 4-in. diameter hole was drilled to a depth of 54.6 ft and cased with 4-in. pipe from land surface to a depth of 44.6 ft followed by 8 ft of 4-in. No. 25 slot and 2 ft of 4-in. No. 14 slot screen. A production test was conducted on November 5, 1962, by representatives of the State Water Survey and Farnsworth & Wylie, Consulting Engineers. After 1.5 hr of pumping at varying rates of 25.2 to 23.8 gpm, the final drawdown was 4.26 ft from a nonpumping water level of 15.98 ft below land surface. Ten min after pumping was stopped, the water level had recovered to 17.17 ft. On the basis of the short-term test data, it was estimated that this test well would yield 30 gpm (43,200 gpd) on a long-term basis.

WELL NO. 3, LABORATORY NO. B109533

		mg/l	me/l	mg/l	me/l
Iron	Fe	1.70	0.06	Silica	SiO ₂ 20
Manganese	Mn	0.05	0.00	Fluoride	F 0.3 0.02
Ammonium	NH ₄	4.4	0.24	Boron	B 0.3
Sodium	Na	42	1.83	Nitrate	NO ₃ 1.8 0.03
Potassium	K	1.9	0.05	Chloride	Cl 2.0 0.06
Calcium	Ca	80	3.99	Sulfate	SO ₄ 10 0.21
Magnesium	Mg	35	2.88	Alkalinity(asCaCO ₃)	436 8.72
Arsenic	As	0.00			
Barium	Ba	0.5		Hardness (as CaCO ₃)	344 6.87
Copper	Cu	0.04		Total dissolved	
Cadmium	Cd	0.00		minerals	497
Chromium	Cr	0.00			
Lead	Pb	0.00		pH (asrec'd)	7.7
Mercury	Hg	0.0000		Radioactivity	
Nickel	Ni	0.0		Alpha pc/l	1.7
Selenium	Se	0.00		±deviation	2.1
Silver	Ag	0.00		Beta pc/l	8.5
Zinc	Zn	0.13		±deviation	2.6

WELL NO. 3 (old grade school well), finished in sand and gravel, was completed in August 1940 to a depth of 196 ft by Clifford Eggers. The well is located on the north side of the old grade school on Monroe St. east of Bloomington St., approximately 1000 ft S and 2500 ft E of the NW corner of Section 35, T31N, R1W. The land surface elevation at the well is approximately 670 ft.

Prior to the construction of Well No. 4, two test holes were drilled in July 1973 by the Albrecht Well Drilling, Inc., Ohio. The first hole, drilled to a depth of 123 ft, was located on the west edge of town and the second hole, drilled to a depth of 163 ft, was located at the site of Well No. 4.

A drillers log of Well No. 3 follows:

WELL NO. 4, finished in sand and gravel, was completed in November 1973 to a depth of 138 ft by Albrecht Well Drilling, Inc., Ohio. The well is located about 0.5 mile south of the village, approximately 40 ft S and 1250 ft E of the NW corner of Section 2, T30N, R1W, Marshall County. The land surface elevation at the well is approximately 660 ft.

Strata	Thickness (ft)	Depth (ft)
Fill and clay	10	10
Clay	20	30
Sand 30-32 ft	5	35
Clay	5	40
Clay and sand	5	45
Clay	5	50
Sand 50-53 ft; water	5	55
Clay	5	60
Clay, red, hard	5	65
Clay	20	85
Clay and sand at 86 ft	5	90
Sand, dirty, very little water	15	105
Clay, sand and gravel mixed in clay	55	160
Clay	10	170
Clay, sandy, caved badly	15	185
Clay, sand at 186 ft, dirty, water	5	190
Sand, dirty	2	192
Sand, clean and water	4	196

A drillers log of Well No. 4 follows:

Strata	Thickness (ft)	Depth (ft)
Yellow clay	11	11
Yellow gravel	2	13
Gray clay	37	50
Dark clay	18	68
Brown clay	5	73
Gravel 1/8 in. (no water)	3	76
Brown clay	7	83
Sand and gravel (no water)	6	89
Green clay	5	94
Gray clay	6	100
Soft black clay	2	102
Gravel	2	104
Gray clay	3	107
Gravel	1	108
Gray clay	4	112
Gravel mixed small to coarse, some sand (water bearing)	26	138

A 4-in. diameter hole was drilled to a depth of 196 ft. The well is cased with 4-in. pipe from within a 5-ft deep pit to a depth of 192 ft followed by 4 ft of No. 12 slot Johnson screen. The top of the casing is equipped with a pitless adapter.

An 8-in. diameter hole was drilled to a depth of 138 ft. The well is cased with 8-in. pipe from 3.2 ft above land surface to a depth of 128 ft followed by 10 ft of 8-in. No. 50 slot Johnson stainless steel screen.

Upon completion, the well reportedly produced 6 gpm with a drawdown of 30 ft from a nonpumping water level of 35 ft.

This well was acidized in 1972 but the results of this work were not reported.

The pumping equipment presently installed is a submersible turbine pump rated at 15 gpm, and powered by an electric motor.

A production test was conducted by the driller on November 13, 1973. After 4 hr of pumping at rates of 100 to 112 gpm, the final drawdown was 5.02 ft from a nonpumping water level of 99.04 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 99.60 ft. On the basis of available information, the Water Survey stated that the well appeared capable of sustaining a long-term production rate of 100 gpm (144,000 gpd).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B109533) is for a water sample from the well collected April 23, 1973, after 40 min of pumping at 15 gpm.

The pumping equipment presently installed is a Red Jacket submersible pump (No. 1006R4-4HB) set at about 125 ft, rated at 100 gpm, and powered by a 10-hp Red Jacket electric motor.

The following mineral analysis (Lab. No. 197361) is for a water sample from the well collected November 7, 1974, after 40 min of pumping at 100 gpm:

WELL NO. 4, LABORATORY NO. 197361

		mg/l	me/l			mg/l	me/l
Iron (total)	Fe	5.9		Silica	SiO ₂	17.3	
Manganese	Mn	0.05		Fluoride	F	0.6	
Ammonium	NH ₄	7.0	0.39	Boron	B	0.3	
Sodium	Na	41.1	1.79	Nitrate	NO ₃	0.7	0.01
Potassium	K	2.0	0.05	Chloride	Cl	3	0.08
Calcium	Ca	66.0	3.29	Sulfate	SO ₄	0.0	0.00
Magnesium	Mg	33.0	2.71	Alkalinity(asCaCO ₃)		404	8.08
Strontium	Sr	0.51	0.01				
Barium	Ba	0.2		Hardness (as CaCO ₃)		300	6.00
Copper	Cu	0.00					
Cadmium	Cd	0.00		Total dissolved minerals		415	
Chromium	Cr	0.00					
Lead	Pb	< 0.05					
Lithium	Li	0.00		Turbidity		31	
Nickel	Ni	< 0.05		Color		10	
Zinc	Zn	0.04		Odor		0	

MARK

The village of Mark (379) installed a public water supply in 1911. Finished water for this supply is obtained from the village of Granville (*see Granville*). In 1950 there were 100 services. In 1974 there were 135 services, all metered; the average daily pumpage was 27,000 gpd.

STANDARD

The village of Standard (282) installed a public water supply in 1914. One well is in use. In 1951 there were 90 services, none metered; the average daily pumpage was 10,000 gpd. In 1975 there were 100 services, none metered; the average and maximum daily pumpages were 8500 and 9000 gpd, respectively. The water is not treated. The natural fluoride concentration in the water is adequate to satisfy state requirements.

WELL NO. 1, finished in St. Peter Sandstone, was completed in 1914 to a depth of 1767 ft. This well was initially drilled for the B. F. Berry Coal Mining Co. The well is located about 0.3 mile south of the Chicago, Milwaukee, St. Paul & Pacific RR station, approximately 1090 ft N and 350 ft W of the SE corner of Section 11, T32N, R1W. The land surface elevation at the well is approximately 690 ft"

A sample study and 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 SYSTEM		
"Loam, clay and sand"	33	33
"Gravel, water-bearing"	3	36
"Clay, red"	55	91
PENNSYLVANIAN SYSTEM		
"Shale, thin limestone, sandstone and coal beds"	409	500
Shale, some siltstone at base	105	605
SILURIAN SYSTEM		
Niagaran-Alexandrian dolomite and limestone	480	1085
ORDOVICIAN SYSTEM		
Maquoketa shale and limestone	165	1250
Galena-Platteville dolomites	350	1600
St. Peter sandstone	167	1767

Originally, the well was cased with 16-in. pipe from land surface to a depth of 95 ft, 12-in. pipe from 95 ft to a depth of 287 ft, 10-in. pipe from 287 ft to a depth of 346 ft, and 6-in. pipe from 300 ft to a depth of 1297 ft. The hole was finished 6 in. in diameter from 1297 to 1767 ft. In January

Table 1. Chemical Analyses of Water Samples Collected from Well No. 1

Lab. No.	Date	Iron (Fe)	Sodium (Na)	Chloride (Cl)	Sulfate (SO ₄)	Alkalinity	Hardness	Total dissolved minerals
SWS-38598	Nov. 1917	1.4	319	340	199	242	194	1084
DPH-	Oct. 1921	2.0		315	197	260	162	1089
DPH-	Mar. 1928	0.4		320	226	250	194	1073
SWS-109929	Apr. 1947	2.2	1188	1675	143	312	237	3279
SWS-147877	Oct. 1958	3.3		3100	78	412	260	5668
SWS-148133	Nov. 1958	4.2		3250	73	412	256	5844
EPA-03448	Dec. 1971							7140
EPA-B109396	Apr. 1973	3.3	2400	3600	67	416	261	6043
EPA-B110897	Apr. 1974	3.8	2550	3690	47	426	238	6333

1958, L. F. Winslow, Walcott, Iowa, installed an 8-in. pipe to a depth of 300 ft and 4-in. pipe from 300 ft to a depth of 1250 ft.

Nonpumping water levels in 1917 and January 1947 were 100 and 165 ft below land surface, respectively.

In April 1957, the well reportedly produced 20 gpm with a drawdown of 5 ft from a nonpumping water level of 181 ft.

On November 5, 1958 the well was pumped for 5.8 hr at a rate of 25 gpm with a drawdown of 10.0 ft from a nonpumping water level of 180.5 ft.

The pumping equipment presently installed is a Sumo submersible pump (Model No. P100C5, Serial No. P14775H) rated at 68 gpm at about 220 ft TDH, and powered by a 7 1/2-hp 3450 rpm electric motor.

The analyses in table 1 indicate that the mineral content of the water from this well has increased since the well was constructed. Until 1928 water suitable for most uses was pumped from the well which originally was open only to the Galena-Platteville Dolomite and St. Peter Sandstone (see log and casing record). The water became more highly mineralized between 1928 and 1958, suggesting that the casing was corroded allowing water to enter the well from shallower formations. The units above the Galena-Platteville Dolomite are known to yield highly mineralized water.

A new casing was installed in January 1958 in an attempt to improve the mineral quality of the water. A water quality

and temperature study conducted in November 1958 by the State Water Survey showed that a considerable part of the water pumped was entering the well bore between depths of 700 to 1100 ft. Available quality data in 1973 and 1974 suggest that a larger portion of the water now pumped may be from these overlying units.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B110897) is for a water sample from the well collected April 22, 1974, after 30 min of pumping at 60 gpm. Hydrogen sulfide was apparent when a previous sample was collected.

WELL NO. 1, LABORATORY NO. B110897

	mg/l	me/l	mg/l	me/l
Iron	Fe 3.8		Silica	SiO ₂ 8
Manganese	Mn 0.00		Fluoride	F 2.4 0.13
Ammonium	NH ₄ 2.7 0.15		Boron	B 2.5
Sodium	Na 2550 110.92		Nitrate	NO ₃ 0.0 0.00
Potassium	K 19.1 0.49		Chloride	Cl 3690 104.06
Calcium	Ca 59 2.94		Sulfate	SO ₄ 47 0.98
Magnesium	Mg 22 1.81		Alkalinity(as CaCO ₃)	426 8.52
Arsenic	As 0.00			
Barium	Ba 0.0		Hardness (as CaCO ₃)	238 4.76
Copper	Cu 0.02			
Cadmium	Cd 0.01		Total dissolved minerals	6333
Chromium	Cr 0.00			
Lead	Pb 0.00			
Mercury	Hg 0.0004		pH(as rec'd)	8.2
Nickel	Ni 0.2		Radioactivity	
Selenium	Se 0.00		Alpha pc/l	12.8
Silver	Ag 0.00		±deviation	12.5
Cyanide	CN 0.00		Beta pc/l	24.0
Zinc	Zn 0.02		±deviation	19.0