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Public Groundwater Supplies
in Macoupin County

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PUBLIC GROUNDWATER SUPPLIES IN MACOUPIN COUNTY

by Dorothy M. Woller

Introduction

This publication presents all available information on production wells used for public groundwater supplies in Macoupin 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 4 municipalities and 1 state park in Macoupin 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. The work was done under the direct guidance of William H. Walker, Hydrologist. Special thanks are given to E. W. Sanderson, Assistant Engineer, who checked all of the data and reviewed the manuscript. Mrs. J. L. Ivens and Mrs. P. A. Motherway edited the manuscript, Mrs. Suzi O'Connor typed the camera-copy, and John W. Brother, Jr., prepared the illustration. 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. Ross D. Brower, Assistant Geologist, Illinois State Geological Survey, reviewed the geological discussion. 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 Macoupin County is described generally in Illinois State Geological Survey Circular 225, *Groundwater Geology in South-Central Illinois*. The following brief discussion of geologic conditions in the county is taken largely from that 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 glacial drift deposits forming the present day land surface in Macoupin County are generally thin (less than 50 ft). Water-yielding sand and gravel deposits are present locally in the valleys of Nassa Creek, Otter Creek, Cahokia Creek, and Bear Creek and in the partially buried bedrock valley of Macoupin Creek. However, considerable test drilling usually is required to determine the thicker and more

permeable parts of these aquifers suitable for furnishing moderate quantities of water. In nearly all of the county, water for domestic use is obtained from large-diameter bored wells tapping thin stringers or lenses of silt, sand, and gravel in the glacial drift.

Beneath the glacial deposits are the upper bedrock units of Pennsylvanian age. These rocks consist principally of shale with only thin beds of water-yielding sandstone or creviced limestone. Limited quantities of water for farm and domestic supplies are obtained from these units at depths of 70 to 200 ft below land surface in the extreme northern part and in local areas of the central and southeastern parts of the county. Water contained in these rocks below depths of 200 ft usually is too highly mineralized for most uses.

Groundwater Development for Municipal Use

Groundwater is used as a source of municipal supply at Beaver Dam State Park, Chesterfield, and Medora. The groundwater supplies at Modesto and Palmyra have been abandoned and water is now obtained from a reservoir built by the Modesto-Palmyra Water Commission. The locations of these public water supply systems are shown in figure 1.

Sand and gravel deposits in the unconsolidated materials above bedrock are tapped as the sources for Beaver Dam State Park, Chesterfield, and Medora (two Medora wells are located in Jersey County). There are presently five public supply production wells, ranging in depth from 34 to 54 ft, finished in the sand and gravel deposits. Their reported yields range from 15 to 150 gpm depending primarily upon the type of well and the permeability, thickness, and areal extent of the sand and gravel deposits tapped by each well. Production estimates in 1972 and 1975 indicate total withdrawal was about 71,500 gpd. Past and present analyses of water from the three groundwater supplies indicate that the iron content ranges from 3.1 to 19 mg/l, and the hardness from 176 to 580 mg/l. Water at Beaver Dam State Park is aerated, filtered, and chlorinated. Water at Chesterfield is aerated, filtered, softened, chlorinated, and fluoridated. Water at Medora is aerated, chlorinated, fluoridated, treated with caustic soda, and filtered.

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.

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 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 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.

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 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. Approximate equivalent slot openings for other types of screens are given in parentheses after the screen designation.

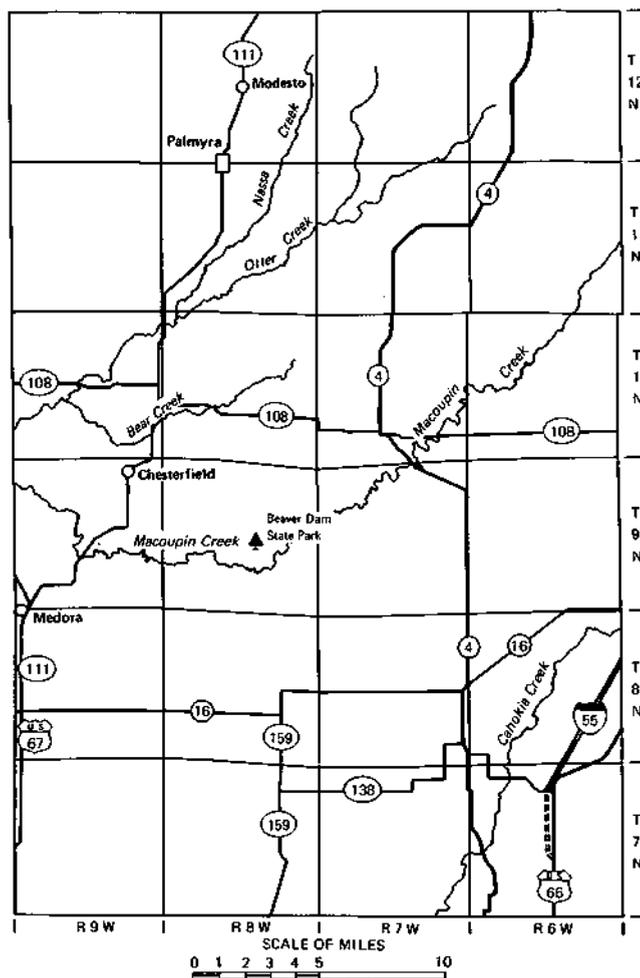


Figure 1. Past and present location of public groundwater supply systems in Macoupin County

Abbreviations Used

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

BEAVER DAM STATE PARK

Beaver Dam State Park, located 3.5 miles north of Plainview, installed a public water supply in 1964. Two wells (Nos. 6 and 7) serve the ranger's house plus 12 hydrants and 8 drinking fountains in the camping and picnic areas. In 1972 the average and maximum daily pumpages were estimated to be about 1500 and 7000 gpd, respectively. The water is aerated, filtered, and chlorinated.

WELL NO. 1, finished in sand and gravel, was originally constructed to a depth of 50 ft and then rebuilt in 1948. This well was capped in 1970 and is no longer in use. The well is located 75 ft south of the front of the ranger's residence, approximately 2480 ft N and 1750 ft E of the SW corner of Section 22, T9N, R8W. The land surface elevation at the well is approximately 590 ft.

The well is cased with brick walls from 2 ft above land surface to a depth of 50 ft.

WELL NO. 2, finished in Pennsylvanian rocks, was completed in 1950 to a depth of 170 ft. This well was abandoned and sealed prior to 1966. The well reportedly was located about 25 ft from Well No. 1 in the SW quarter of Section 22, T9N, R8W. The land surface elevation at the well is approximately 590 ft.

WELL NO. 3, finished in Pennsylvanian rocks, was completed in 1950 to a depth of 108 ft. This well was abandoned about 1953 and sealed prior to 1966. The well was located in the north section of the park near the picnic area in the NW quarter of Section 22, T9N, R8W.

WELL NO. 4, finished in sand and gravel, was constructed in 1953 to a depth of 22 ft. This well was abandoned and sealed prior to 1966. The well was located about 30 ft from Well No. 3 in the NW quarter of Section 22, T9N, R8W.

The well was cased with 4-ft diameter brick walls to a depth of 22 ft.

WELL NO. 5, finished in sand and gravel, was constructed in 1953 to a depth of 29 ft. This well was abandoned and sealed in 1965. The well was located 40 ft west of the iron removal treatment plant about 100 ft east of the park garage, approximately 2500 ft S and 1750 ft E of the NW corner of Section 22, T9N, R8W. The land surface elevation at the well is approximately 560 ft.

The well was cased with 5-ft diameter walls to a depth of 29 ft.

WELL NO. 6, finished in sand and gravel, was completed in November 1962 to a depth of 34 ft by E. C. Baker & Sons, Sigel. The well is located about 1 mile south of the park about 100 ft north of Macoupin Creek and 10 ft west of the Carlinville-Plainview county road bridge over the creek, approximately 405 ft S and 325 ft E of the NW corner of Section 27, T9N, R8W. The land surface elevation at the well is approximately 520 ft.

A 6-in. diameter hole was drilled to a depth of 39 ft. The well is equipped with a 7-in. diameter Monitor pitless adapter from 12 ft above land surface to a depth of 3 ft and cased

with 6-in. ID steel pipe to a depth of 28 ft followed by 6 ft of 6-in. No. 40 slot Cook red brass screen. An 18-in. corrugated metal pipe extends from 11.5 ft above land surface to a depth of 4 ft to provide flood protection. The annulus between the 18-in. corrugated pipe and the pitless adapter is filled with concrete.

A production test using two observation wells was conducted on December 12, 1962, by representatives of the driller, the State Water Survey, and Casler & Associates, Consulting Engineers. After 5 hr of pumping at a rate of 15 gpm, the final drawdown was 7.54 ft from a nonpumping water level of 12.30 ft below land surface. One hr after pumping was stopped, the water level had recovered to 13.68 ft. On the basis of the production test data, it was estimated that this well would yield 15 gpm (21,600 gpd) on a long-term basis.

The pumping equipment presently installed is a Rapidayton submersible pump (Model No. A7C44) set at 29.5 ft, rated at 15 gpm, and powered by a 3/4-hp electric motor.

A drillers log of Well No. 6 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Soil	1	1
Yellow clay	19	20
Blue sandy clay	7	27
Sand and gravel	7	34
Blue sandy clay	3	37
Shale	2	39

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. A2243) of a sample collected August 5, 1975, after pumping for 35 min at 15 gpm, showed the water to have a hardness of 300 mg/l, total dissolved minerals of 510 mg/l, and an iron content of 5.9 mg/l.

WELL NO. 7, finished in sand and gravel, was completed in June 1966 to a depth of 35.5 ft by E. C. Baker & Sons, Sigel. The well is located about 100 ft north of the north bank of Macoupin Creek and 50 ft east of Well No. 6, approximately 405 ft S and 375 ft E of the NW corner of Section 27, T9N, R8W. The land surface elevation at the well is approximately 520 ft.

A drillers log of Well No. 7 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	2	2
Yellow clay	19	21
Blue sandy clay	9	30
Sand and gravel	5.5	35.5

A 6-in. diameter hole was drilled to a depth of 35.5 ft. The well is equipped with a 7-in. diameter Monitor pitless adapter from 12 ft above land surface to a depth of 3 ft and cased with 6-in. pipe to a depth of 29.5 ft followed by 6 ft of 6-in. No. 25 slot Cook red brass screen. A 21-in. corrugated metal culvert pipe extends from 11.5 ft above land surface to a depth of 6 ft to provide flood protection. The annulus between the 21-in. corrugated pipe and the pit-

less adapter is filled with concrete.

A production test using one observation well was conducted by the State Water Survey on June 14, 1966. After 5.4 hr of pumping at a rate of 20 gpm, the drawdown was 10.56 ft from a nonpumping water level of 11.74 ft below land surface. One hr after pumping was stopped, the water level had recovered to 13.54 ft.

The pumping equipment presently installed is a Baker Manufacturing Co. submersible pump set at 29.5 ft, rated at 15 gpm at about 120 ft TDH, and powered by a 3/4-hp Franklin electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. A2244) is for a water sample from the well collected August 5, 1975, after 35 min of pumping.

WELL NO. 7, LABORATORY NO. A2244					
		mg/l	me/l		mg/l me/l
Iron	Fe	5.8		Silica	SiO ₂ 21
Manganese	Mn	0.85		Fluoride	F 0.4 0.02
Ammonium	NH ₄	0.6	0.03	Boron	B 0.1
Sodium	Na	62	2.70	Nitrate	NO ₃ 0.0 0.00
Potassium	K	0.65	0.02	Chloride	Cl 150 4.23
Calcium	Ca	73	3.64	Sulfate	SO ₄ 45 0.94
Magnesium	Mg	24	1.98	Alkalinity (as CaCO ₃)	185 3.70
Arsenic	As	0.000			
Barium	Ba	0.1		Hardness (asCaCO ₃)	290 5.80
Copper	Cu	0.00			
Cadmium	Cd	0.00		Total dissolved	
Chromium	Cr	0.00		minerals	510
Lead	Pb	0.00			
Mercury	Hg	0.0000		pH (asrec'd)	7.3
Nickel	Ni	0.0		Radioactivity	
Selenium	Se	0.00		Alpha pc/l	0.4
Silver	Ag	0.00		±deviation	1.3
Cyanide	CN	0.000		Beta pc/l	0.9
Zinc	Zn	0.0		±deviation	2.0

CHESTERFIELD

The village of Chesterfield (262) installed a public water supply in 1968. One well is in use. In 1968 there were 40 services, all metered; the estimated average daily pumpage was 14,000 gpd. In 1972 there were 99 services, all metered; the estimated average and maximum daily pumpages were 15,000 and 30,000 gpd, respectively. The water is aerated, filtered, softened, chlorinated, and fluoridated.

Four test holes ranging in depth from 47 to 52 ft were drilled in 1967 by E. C. Baker & Sons, Sigel, prior to the installation of a public water supply. They were located in the NW 1/4 of the SW 1/4 of the SE 1/4 of Section 8, T9N, R9W. One test hole (No. 2) was drilled 6 in. in diameter to a depth of 52 ft and cased with 3.5-in. pipe from land surface to a depth of 38 ft followed by 9.5 ft of 3-in. perforated pipe. A production test using two observation wells was conducted on March 24, 1967, by representatives of the driller, the village, the State Water Survey, and George H. Knostman, Jr., Consulting Engineer. After 3.5 hr of pumping at a rate of 52 gpm, the drawdown was 10.34 ft from a nonpumping water level of 8.19 ft below land surface. One hr after pumping was stopped, the water level had recovered to 8.80 ft. On the basis of the production test data, it was estimated that this test hole would yield 50 gpm (72,000 gpd) on a long-term basis. After this test, the casing and perforated pipe were pulled.

WELL NO. 1, finished in sand and gravel, was completed in October 1967 to a depth of 50 ft by E. C. Baker & Sons, Sigel. The well is located about 1000 ft south of the treatment plant in the Macoupin Creek bottomlands, approximately 1220 ft N and 2500 ft E of the SW corner of Section 8, T9N, R9W. The land surface elevation at the well is approximately 495 ft.

A drillers log of Well No. 1 follows:

Strata	Thickness (ft)	Depth (ft)
Soil and yellow clay	20	20
Yellow sandy clay	21	41
Yellow sand and gravel	4	45
Blue sand and gravel	4.5	49.5
Shale	0.5	50

An 8-in. diameter hole was drilled to a depth of 50 ft. The well is equipped with an 8-in. diameter pitless adapter from 6.3 ft above land surface to a depth of 4 ft and cased with 6-in. steel pipe from 4 ft below land surface to a depth of 44 ft followed by 6 ft of 6-in. No. 30 slot screen. An 18-in. corrugated metal pipe extends from 5 ft above land surface to a depth of 10 ft to provide flood protection. The annulus between the 18-in. corrugated pipe and the 6-in. casing is filled with poured concrete.

A production test was conducted on February 29, 1968, by representatives of the driller, the village, the State Water Survey, and George H. Knostman, Jr., Consulting Engineer. After 2 hr of pumping at a rate of 61 gpm, the drawdown was 14.35 ft from a nonpumping water level of 11.28 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 12.00 ft. On the basis of the production test data, it was estimated that this well would yield about 65 gpm (93,600 gpd) on a long-term basis.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump (Model No. 282 1022 200) set at 44 ft, rated at 50 gpm, and powered by a 3-hp 3450 rpm electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. A0813) is for a water sample from the well collected July 14, 1975, after 1 hr of pumping at 60 gpm.

WELL NO. 1, LABORATORY NO. A0813

		mg/l	me/l			mg/l	me/l
Iron	Fe	3.7		Silica	SiO ₂	19	
Manganese	Mn	0.60		Fluoride	F	0.2	0.01
Ammonium	NH ₄	0.6	0.03	Boron	B	0.1	
Sodium	Na	14	0.61	Nitrate	NO ₃	2.6	0.04
Potassium	K	1.0	0.03	Chloride	Cl	23	0.65
Calcium	Ca	118	5.89	Sulfate	SO ₄	120	2.50
Magnesium	Mg	43	3.54	Alkalinity(as CaCO ₃)		330	6.60
Arsenic	As	0.001					
Barium	Ba	0.2		Hardness (asCaCO ₃)		471	9.42
Copper	Cu	0.00					
Cadmium	Cd	0.00		Total dissolved			
Chromium	Cr	0.00		minerals		580	
Lead	Pb	0.00					
Mercury	Hg	0.0000		pH (asrec'd)		7.9	
Nickel	Ni	0.0		Radioactivity			
Selenium	Se	0.00		Alpha pc/l		0.0	
Silver	Ag	0.00		± deviation		0.0	
Cyanide	CN	0.000		Beta pc/l		0.4	
Zinc	Zn	0.0		±deviation		2.2	

MEDORA

The village of Medora (505) installed a public water supply in 1963. Although this village is in Macoupin County, the wells are located about 5 miles north and 2 miles west in Jersey County. Two wells are in use for this village and water is also furnished to the communities of Kemper in Jersey County and Rockbridge in Greene County. In 1964 there were 180 services, all metered; the average daily pumpage was estimated to be 15,000 to 20,000 gpd. In 1975 there were 265 services, all metered (including Kemper and Rockbridge); the average and maximum daily pumpages were 55,000 and 65,000 gpd, respectively. The water is aerated, chlorinated, fluoridated, treated with caustic soda, and filtered.

WELL NO. 1, finished in sand and gravel, was completed in February 1963 to a depth of 54 ft by the Layne-Western Co., Kirkwood, Mo. The well is located in the Macoupin Creek floodplain about 5 miles north and 2 miles west of the village inside the water treatment plant about 50 ft east of U.S. Route 67, approximately 1700 ft S and 1000 ft W of the NE corner of Section 3, T9N, R10W, Jersey County. The land surface elevation at the well is approximately 480 ft.

A drillers log of Well No. 1 follows:

Strata	Thickness (ft)	Depth (ft)
Clay	22	22
Sand, medium	16	38
Coarse sand and gravel	17	55
Fine sand	3	58
Clay	2	60
Shale	3	63

A 20-in. diameter hole was drilled to a depth of 54 ft. The well is cased with 16-in. pipe from 2 ft below the pumphouse floor (9 ft above original land surface) to a depth of 15.7 ft and 8-in. pipe from 1.2 ft above the pumphouse floor to a

depth of 44 ft followed by 10 ft of 8-in. No. 6 (0.080 in.) Layne stainless steel shutter screen. The annulus between the bore hole and 16-in. casing and between the bore hole and 8-in. casing-screen assembly is filled with grout to a depth of 15.7 ft below original land surface and with Merramec gravel from 15.7 to 54 ft and the annulus between the 16- and 8-in. casings is filled with grout to a depth of 15.7 ft.

A production test was conducted on March 5, 1963, by representatives of the driller, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 5 hr of pumping at a rate of 100 gpm, the final drawdown was 6.63 ft from a nonpumping water level of 15.30 ft below land surface. One hr after pumping was stopped, the water level had recovered to 15.48 ft. On the basis of the production test data, it was estimated that this well should yield 50 gpm (72,000 gpd) on a long-term basis.

This well was acidized in 1964 by the Layne-Western Co., Kirkwood, Mo., and the production was restored to 64 gpm. Acidizing in 1966 by this company improved the production to 80 gpm with a pumping water level of 32 ft below the pump base.

This well was acidized in 1970 and 1972 by the Layne-Western Co. In 1970 after acidizing, the production was reported to be 70 to 75 gpm with a drawdown of 4 ft and a pumping water level of 30 ft. Similar results were obtained when the work was completed in 1972.

The pumping equipment presently installed is a Layne & Bowler turbine pump set at 50 ft, rated at 50 gpm at about 75 ft TDH, and powered by a 3-hp 1455 rpm General Electric motor.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B138235) of a sample collected May 7, 1975, after pumping for 1 hr at 40 gpm, showed the water to have a hardness of 299 mg/l, total dissolved minerals

of 397 mg/l, and an iron content of 15.5 mg/l. Hydrogen sulfide was apparent when a previous sample was collected.

WELL NO. 2, finished in sand and gravel, was completed in June 1972 to a depth of 50 ft by the Layne-Western Co., Kirkwood, Mo. The well is located about 300 ft north of Well No. 1, approximately 1400 ft S and 1000 ft W of the NE corner of Section 3, T9N, R10W, Jersey County. The land surface elevation at the well is approximately 480 ft.

A drillers log of Well No. 2 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Brown clay	21	21
Fine sand	4	25
Coarse sand and gravel	26	51
Shale	3	54

A 20-in. diameter hole was drilled to a depth of 50 ft. The well is cased with 8-in. pipe from 10 ft above land surface to a depth of 40 ft followed by 10 ft of 8-in. No. 6 (0.080 in.) Layne shutter screen. A 30-in. pipe extends from 9 ft above original land surface to a depth of 13 ft to provide flood protection. The annulus between the bore hole and 30-in. pipe and between the bore hole and 8-in. casing-screen assembly is filled with grout to a depth of 13 ft below original land surface and with gravel from 13 to 50 ft and the annulus between the 30- and 8-in. casings is filled with grout to a depth of 13 ft.

A production test was conducted on June 19, 1972, by representatives of the driller, the village, the State Water Survey, and Devore-Bobb & Associates, Inc., Consulting

Engineers. After 2 hr of pumping at a rate of 200 gpm, the drawdown was 12.14 ft from a nonpumping water level of 16.40 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 18.07 ft. On the basis of the production test data, it was estimated that this well could yield as much as 150 gpm (216,000 gpd) on a long-term basis.

The pumping equipment presently installed is a Layne turbine pump set at 40 ft, rated at 50 gpm, and powered by a 3-hp U.S. electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B121255) is for a water sample from the well collected January 14, 1975, after 1 hr of pumping at 60 gpm.

WELL NO. 2, LABORATORY NO. B121255

	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>
Iron	Fe	15	Silica	SiO ₂	27
Manganese	Mn	1.2	Fluoride	F	0.1
Ammonium	NH ₄	1.54	Boron	B	0.0
Sodium	Na	8	Nitrate	NO ₃	0.7
Potassium	K	0.9	Chloride	Cl	15
Calcium	Ca	85	Sulfate	SO ₄	56
Magnesium	Mg	23	Alkalinity (as CaCO ₃)		265
Arsenic	As	0.01			
Barium	Ba	0.1	Hardness (as CaCO ₃)		307
Copper	Cu	0.00			
Cadmium	Cd	0.00	Total dissolved minerals		425
Chromium	Cr	0.00			
Lead	Pb	0.00			
Mercury	Hg	0.0000	pH (as rec'd)		7.2
Nickel	Ni	0.0	Radioactivity		
Selenium	Se	0.00	Alpha <i>pc/l</i>		0.0
Silver	Ag	0.00	± deviation		0.0
Cyanide	CN	0.00	Beta <i>pc/l</i>		0.0
Zinc	Zn	0.0	± deviation		1.5

MODESTO

The village of Modesto (221) installed a public water supply in 1954. A total of two production wells were utilized as a source of water supply until 1965 when the village began using surface water purchased from the Modesto-Palmyra Water Commission. In 1959 there were 94 services, all metered; the average and maximum groundwater pumpages were 4500 and 9000 gpd, respectively. In 1973 there were 112 services, all metered; the average and maximum pumpages from the Water Commission were 8000 and 12,000 gpd, respectively.

WELL NO. 1, finished in limestone, was constructed in April 1954 to a depth of 131 ft (measured in 1960 at 121 ft) by J. Bolliger & Sons, Fairbury, and rehabilitated in 1960 by the Layne-Western Co., Kirkwood, Mo. This well was abandoned about 1966. The well is located in the northwest corner of the pump plant, approximately 1600 ft S and 600 ft E of the NW corner of Section 22, T12N, R8W. The land surface elevation at the well is approximately 685 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	3	3
Yellow clay	17	20
Gray clay (little water)	10	30
Yellow clay	5	35
Gray and yellow clay	5	40
Yellow clay	15	55
Dark clay	5	60
Coal (3 gpm)	4	64
Gray shale (5 gpm)	16	80
Shale and lime	30	110
Lime	10	120
Soft lime	10	130

A 6-in. diameter hole was drilled to a depth of 61 ft and finished 4 in. in diameter from 61 to 131 ft. Originally, the well was cased with 6-in. pipe from 1.5 ft above land surface to a depth of 61 ft. After rehabilitation work in 1960, the well was reported to be cased with 6-in. pipe from 1.5 ft above land surface to a depth of 53 ft and 4-in. perforated pipe from 53 ft to a depth of 121 ft.

A production test using two observation wells was conducted on April 22, 1954, by representatives of the driller,

the village, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 12.3 hr of pumping at rates of 25.5 to 11.1 gpm, the drawdown was 41.2 ft from a non-pumping water level of 26.7 ft below land surface. Twenty-one min after pumping was stopped, the water level had recovered to 51.7 ft.

This well was rehabilitated and acidized in 1960 by the Layne-Western Co., Kirkwood, Mo., and the reported production rate was less than 3 gpm.

In 1964, the Layne-Western Co. bailed and surged the well and installed a new 5-gpm pump. The production rate was reported to be 6 gpm with 42 ft of drawdown.

A mineral analysis of a sample (Lab. No. 134671) collected during the initial production test, after pumping for 12 hr at 11.1 gpm, showed the water to have a hardness of 284 mg/1, total dissolved minerals of 670 mg/1, and an iron content of 4.7 mg/1.

WELL NO. 2, finished in sandstone, was completed in October 1955 to a depth of 107 ft by J. B. Bushnell, Plymouth. This well was abandoned in 1966. The well is located about 400 ft north and 2050 ft east of Well No. 1, approximately 1200 ft S and 2650 ft E of the NW corner of Section 22, T12N, R8W. 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>
Top soil	5	5
Yellow clay	18	23
Hardpan	12	35
Green mud	7	42

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Gray shale	10	52
Sandstone — coal lenses	6	58
Coal lenses	10	68
Coal	3	71
Fire clay and sandrock lenses	12	83
Sandrock	24	107

An 8-in. diameter hole was drilled to a depth of 51 ft and finished 6 in. in diameter from 51 to 107 ft. The well is cased with 8-in. pipe from 0.5 ft above land surface to a depth of 50.5 ft and 6-in. perforated pipe from 49 ft to a depth of 107 ft.

A production test was conducted on October 24-25, 1955, by representatives of the driller, the village, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 22.8 hr of intermittent pumping at rates ranging from 21 to 43.5 gpm, the final drawdown was 54.2 ft from a non-pumping water level of 14.0 ft below land surface. The water level recovered to 33.2 ft after the pumping was stopped for 1.2 hr.

A production test was conducted by the State Water Survey on October 15, 1957. After 7.1 hr of pumping at rates ranging from 19 to 30 gpm, the final drawdown was 38.7 ft from a nonpumping water level of 14.9 ft. The well then broke suction and the pump was turned off. Twelve min after pumping was stopped, the water level had recovered to 33.8 ft.

A partial analysis of a sample (Lab. No. 144760) collected October 15, 1957, showed the water to have a hardness of 284 mg/1, total dissolved minerals of 769 mg/1, and an iron content of 1.1 mg/1.

PALMYRA

The village of Palmyra (776) installed a public water supply in 1953. A total of six production wells were utilized as a source of water supply until 1966 when the village began using surface water purchased from the Modesto-Palmyra Water Commission. In 1954 there were 290 services, 8 metered; the average groundwater pumpage was 20,000 gpd. In 1973 there were 286 services, all metered; the average and maximum pumpages from the Water Commission were 40,000 and 45,000 gpd, respectively.

Prior to the installation of the public water supply, several test holes were drilled in 1952 by E. C. Baker & Sons, Sigel. These test holes were located in the flat of Nassa Creek about 2 miles southeast of the village.

WELL NO. 1, finished in sand and gravel, was completed in April 1952 to a depth of 26 ft by E. C. Baker & Sons, Sigel. This well was abandoned about 1969. The well is located on the south side of Nassa Creek about 2 miles south-

east of the village, approximately 1300 ft N and 1150 ft E of the SW corner of Section 2, T11N, R8W. The land surface elevation at the well is 581.3 ft.

A sample study summary log of Test Well No. 7A located 7 ft north 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, dark brown, silty, sandy noncalcareous	2	2
Till, dark yellowish brown, silty, noncalcareous	16.5	18.5
Sand, fine to medium, clean, slightly noncalcareous	8.5	27
Till, very dark brown, silty, calcareous	3	30
PENNSYLVANIAN SYSTEM		
Shale, dark green gray, sandy, weak	1	31

A 6.8-in. diameter hole was drilled to a depth of 31 ft. The well is cased with 6.6-in. OD pipe from about 9 ft above

original land surface to a depth of 22 ft followed by 4 ft of 6-in. No. 35 slot screen. A 24-in. steel pipe extends from about 10 ft above original land surface to a depth of 3 ft and is surrounded by a sloping earth berm to provide flood protection. The annulus between the 24-in. steel pipe and the 6.6-in. casing is filled with concrete.

A production test using seven observation wells was conducted on May 2, 1952, by representatives of the driller, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 3 hr of pumping at rates of 29.2 to 24.4 gpm, the drawdown was 16.92 ft from a nonpumping water level of 4.87 ft below land surface. Thirty-five min after pumping was stopped, the water level had recovered to 5.95 ft.

A partial analysis of a sample (Lab. No. 128587) collected during the initial production test, after pumping for 2.8 hr at 24.4 gpm, showed the water to have a hardness of 391 mg/1, total dissolved minerals of 488 mg/1, and an iron content of 10.8 mg/1.

WELL NO. 2, finished in sand and gravel, was completed in April 1952 to a depth of 24.7 ft by E. C. Baker & Sons, Sigel. This well was abandoned and sealed about 1969. The well was located on the north side of Nassa Creek about 195 ft northeast of Well No. 1, approximately 1488 ft N and 1200 ft E of the SW corner of Section 2, T11N, R8W. The land surface elevation at the well is 581.9 ft.

A drillers log of Well No. 2 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	1	1
Dirty sand	19	20
Sand and gravel	5	25
Shale	1	26

A 6.8-in. diameter hole was drilled to a depth of 26 ft. The well was cased with 6.6-in. OD pipe to a depth of 20.7 ft followed by 4 ft of 6-in. No. 65 slot screen. A 24-in. steel pipe extended from about 10 ft above original land surface to a depth of 3 ft and was surrounded by a sloping earth berm to provide flood protection. The annulus between the 24-in. steel pipe and the 6.6-in. casing was filled with concrete.

A production test using five observation wells was conducted on May 1-2, 1952, by representatives of the driller, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 24.2 hr (except for a 7-min break) of pumping at rates ranging from 24.6 to 28.0 gpm, the drawdown was 14.46 ft from a nonpumping water level of 6.10 ft below land surface. Twenty-nine min after pumping was stopped, the water level had recovered to 6.31 ft.

A partial analysis of a sample (Lab. No. 144801) collected October 15, 1957, after pumping for 15 min at 15 gpm, showed the water to have a hardness of 552 mg/1, total dissolved minerals of 647 mg/1, and an iron content of 8.5 mg/1.

WELL NO. 3, finished in sand and gravel, was completed in April 1952 to a depth of 22.5 ft by E. C. Baker & Sons, Sigel. This well was abandoned and sealed about 1969. The

well was located on the north side of Nassa Creek about 94 ft northwest of Well No. 2, approximately 1550 ft N and 1128 ft E of the SW corner of Section 2, T11N, R8W. The land surface elevation at the well is 580.5 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	2	2
Dirty sand	16	18
Sand and gravel	4.5	22.5
Shale	0.5	23

A 6.8-in. diameter hole was drilled to a depth of 23 ft. The well was cased with 6.6-in. OD pipe to a depth of 18.5 ft followed by 4 ft of 6-in. No. 65 slot screen. A 24-in. steel pipe extended from about 10 ft above original land surface to a depth of 3 ft and was surrounded by a sloping earth berm to provide flood protection. The annulus between the 24-in. steel pipe and the 6.6-in. casing was filled with concrete.

A production test using six observation wells was conducted on May 2, 1952, by representatives of the driller, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 3.2 hr of pumping at rates of 10.5 to 28.4 gpm, the drawdown was 13.47 ft from a nonpumping water level of 3.93 ft below land surface. Eighteen min after pumping was stopped, the water level had recovered to 4.34 ft.

A partial analysis of a sample (Lab. No. 128588) collected during the initial production test, after pumping for 2 hr at 28.4 gpm, showed the water to have a hardness of 378 mg/1, total dissolved minerals of 419 mg/1, and an iron content of 7.9 mg/1.

WELL NO. 4, finished in sand and gravel, was completed in April 1952 to a depth of 23 ft by E. C. Baker & Sons, Sigel. This well was abandoned and sealed about 1969. The well was located on the north bank of Nassa Creek about 90 ft southwest of Well No. 3, approximately 1486 ft N and 1063 ft E of the SW corner of Section 2, T11N, R8W. The land surface elevation at the well is 582.4 ft.

A drillers log of Well No. 4 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	2	2
Dirty sand	15.5	17.5
Sand and gravel	5.5	23

A 6.8-in. diameter hole was drilled to a depth of 23 ft. The well was cased with 6.6-in. OD pipe to a depth of 19 ft followed by 4 ft of 6-in. No. 65 slot screen. A 24-in. steel pipe extended from about 10 ft above original land surface to a depth of 3 ft and was surrounded by a sloping earth berm to provide flood protection. The annulus between the 24-in. steel pipe and the 6.6-in. casing was filled with concrete.

A production test using six observation wells was conducted on May 2, 1952, by representatives of the driller, the State Water Survey, and Caldwell-Rhoads Co., Consulting Engineers. After 3.2 hr of pumping at rates of 24.6 to 22.0 gpm, the drawdown was 12.58 ft from a nonpumping water

level of 6.17 ft below land surface. Twenty min after pumping was stopped, the water level had recovered to 6.75 ft.

A partial analysis of a sample (Lab. No. 128589) collected during the initial production test, after pumping for 2 hr at 22 gpm, showed the water to have a hardness of 391 mg/l, total dissolved minerals of 424 mg/l, and an iron content of 6.1 mg/l.

WELL NO. 5, finished in sand and gravel, was constructed in 1960 to a depth of 33 ft by the Rimby Drilling Co., Roodhouse. This well was abandoned and sealed about 1969. The well was located between Well Nos. 3 and 4 in the SE quarter of the NW quarter of the SW quarter of Section 2, T11N, R8W. The land surface elevation at the well is approximately 580 ft.

A hole was dug approximately 8 ft in diameter to a depth of 33 ft. The well was cased with 8-in. steel pipe from 4 ft

above land surface to a depth of 21 ft and 6-ft diameter reinforced concrete pipe from 21 ft to a depth of 33 ft. A concrete cover was placed on top of the concrete pipe. Above the concrete cover, the hole was filled with dirt from 0 to about 21 ft and the annulus between the hole and concrete casing was filled with gravel from about 21 to 33 ft.

WELL NO. 6, finished in sand and gravel, was completed in 1960 to a depth of 28 ft by the Rimby Drilling Co., Roodhouse. This well was abandoned about 1969. The well is located about 300 ft south of Well No. 1, approximately 1000 ft N and 1150 ft E of the SW corner of Section 2, T11N, R8W. The land surface elevation at the well is approximately 580 ft.

The well is cased with 8-in. steel pipe from 4 ft above land surface to a depth of 8 ft and 36-in. reinforced concrete pipe from 8 ft to a depth of 28 ft. A concrete cover was placed on top of the concrete pipe.