GROUND WATER

RESOURCES

IOWA GEOLOGICAL SURVEY
Research and Service 1855-1858 1866-1869 1892- Water—Minerals—Environment

Lee County

Open File Report 80-56 WRD

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GROUND-WATER RESOURCES OF LEE COUNTY

Introduction

Approximately 8.0 percent of the water used in Lee County comes from underground sources. It is estimated that the use of ground water in the county currently approaches 2.8 billion gallons per year. For comparison, this amount would provide each resident with 172 gallons of water a day during a year. Actually, few if any households use this much water, and this greater per capita use reflects the county's commercial, agribusiness, and municipal needs.

The users of ground water in the county draw their supplies from several different geologic sources. Several factors must be considered in determining the availability of ground water and the adequacy of a supply source:

- distribution - having water where it is needed,
- accessibility - affects the cost for drilling wells and pumping water,
- yield - relates to the magnitude of the supply that can be sustained,
- quality - determines for what purposes the water can be used.

In terms of these factors, there are few locations in Lee County where the availability of ground water is not limited to some degree. The most common limitation is poor water quality, that is, highly mineralized ground water. Secondary limitations are generally related to poor distribution, small yields from some sources, and poor accessibility due to the great depths to adequate sources.

Occurrence of Ground Water in Lee County

The occurrence of ground water is influenced by geology -- the position and thickness of the rock units, their ability to store and transmit water, and their physical and chemical make-up. Geologic units that store and transmit water and yield appreciable amounts to wells are called aquifers. The best aquifers are usually composed of unconsolidated sand and gravel, porous sandstone, and porous or fractured limestone and dolomite. Other units with materials such as clay and silt, shale, siltstone, and mudstone yield little or no water to wells. These impermeable units are called aquicludes or aquitards and commonly separate one aquifer unit from another.

In Lee County there are four principal aquifers from which users obtain water supplies. The loose, unconsolidated materials near the land surface comprise the surficial aquifer. Below this there are three major rock aquifers -- the Mississippian aquifer, the Devonian aquifer, and the Cambro-Ordovician aquifer. Although a principal water supply source in several counties, the Devonian aquifer in Lee County cannot be considered for most purposes because its water is highly mineralized. Figure 1 shows the geologic relations of these beneath the county. Each of the aquifers has its own set of geologic, hydrologic, and water quality characteristics which determine the amount and potability (suitability for drinking) of water it will yield.

Surficial Aquifers

Unconsolidated deposits at the land surface are comprised of mixtures of clay, silt, sand, gravel, and assorted boulders. The water-yielding potential of the surficial deposits is greatest in units composed mostly of sand and/or gravel. Three types of surficial aquifers are used: the alluvial aquifer, the drift aquifer, and the buried-channel aquifer.

The alluvial aquifer consists mainly of the sand and gravel transported and deposited by modern streams and makes up the floodplains and terraces in major valleys. Alluvial deposits are shallow, generally less than 50-60 feet and may be contaminated by percolating surface water.

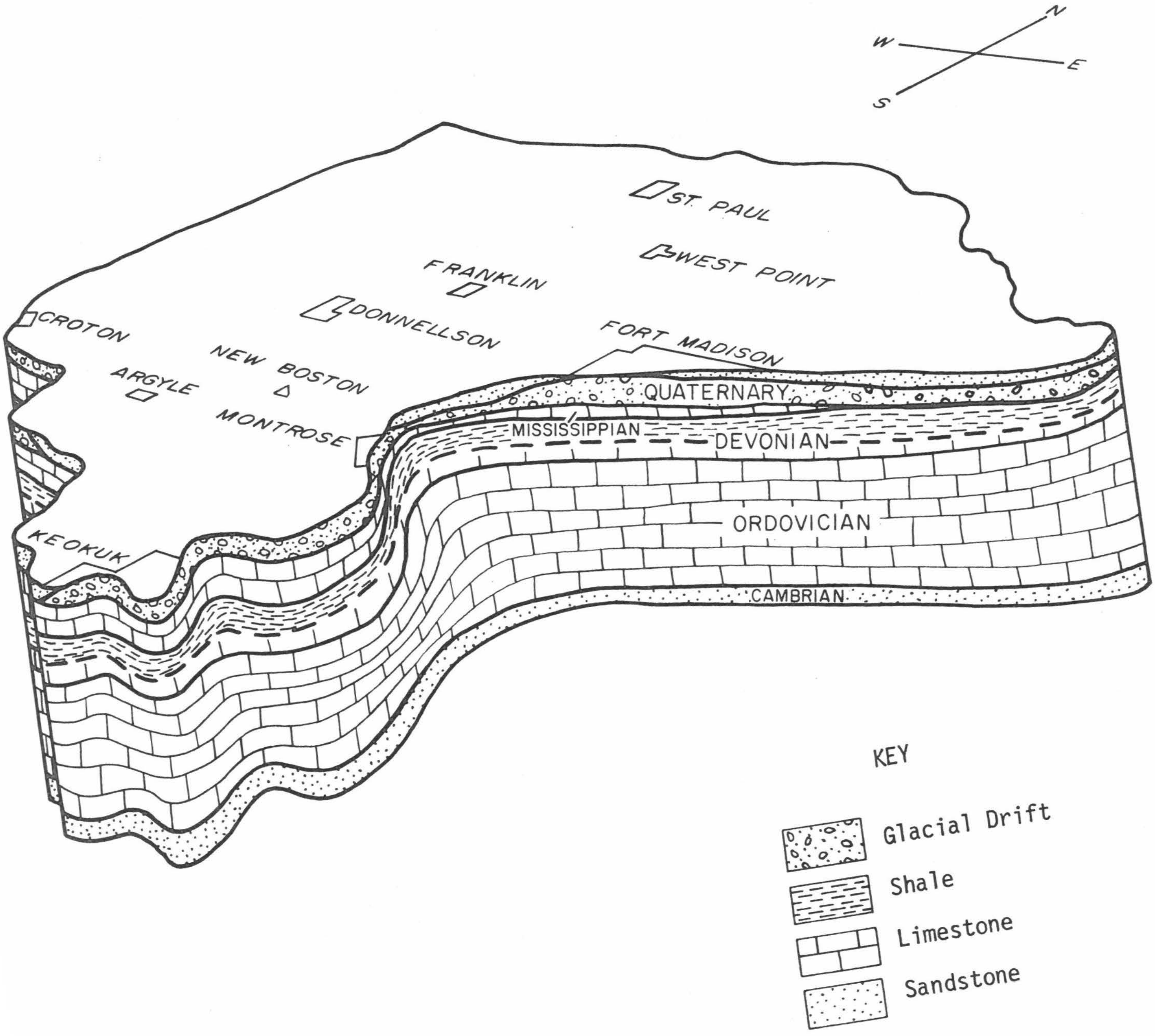
The drift aquifer is the thick layer of soils materials deposited over the bedrock by glacial ice which invaded the county at least twice in the last two million years. The composition of the glacial drift varies considerably, and where it is silty and clayey it does not yield much water. Locally there are lenses or beds of sand and gravel within the drift which are thick and widespread enough to serve as dependable water sources. These lenses are difficult to locate because they are irregular in shape and buried within the drift deposits. Usually one or two sand layers can be found in most places that will yield enough water for domestic needs.

Buried-channel aquifers consist of stream alluvium that partially fills valleys that existed before the glacial period. The valleys, overridden by glaciers, are now buried under glacial and more recent alluvial deposits.

The distribution, yields, and water quality characteristics for the surficial aquifers are summarized in Figures 2, 9, and 13. An indication of aquifer depths can be obtained by comparing the elevations of the top (the land surface) and the bottom (the bedrock surface) of the surficial deposits from Figures 4 and 5. The thickness of the glacial drift and the depth of the buried channels are determined by subtracting bedrock from land surface elevations at selected locations.

Figure 1

BLOCK DIAGRAM SHOWING THE GEOLOGY OF LEE COUNTY



Rock Aquifers

Below the surficial materials is a thick sequence of layered rocks formed from deposits of rivers and shallow seas that alternately covered the state within the last 600 million years. The geologic map (Figure 3) shows the geologic units at the surface of this sequence. These rocks are Mississippian and Pennsylvanian in age. The Pennsylvanian rocks are principally shales and act as an aquiclude. The thickness of the Pennsylvanian rocks varies from 0 feet where Mississippian rocks are uppermost to a maximum of approximately 90-100 feet.

Underlying the Pennsylvanian acquiclude is a sequence of older rocks, parts of which form the three major rock aquifers in Lee County. This sequence and the water-bearing characteristics of the aquifers and aquicludes are shown in Table 1.

Examples of the sequence of rock units encountered in drilling existing wells at various locations in Lee County are indexed and illustrated in Figures 7 and 8. The geologic unit that supplies ground water and the amount of water yielded to the well are shown next to each of the well logs.

The accessibility of ground water in the rock aquifers depends first on the depth to the aquifer. The deeper a well must be, the greater the cost for well construction and pumping. The depths to and thicknesses of units at specific sites will vary somewhat because of irregularities in the elevation of the land surface and in the elevation of the tops of the underlying rock units. Estimates of depths and thicknesses can be made by comparing Figure 4 with the maps of aquifer elevations in Figures 10, 11, and 12. The range in depth below land surface to the top of the county's principal bedrock aquifers is given for each township in Figure 6.

The second factor which affects accessibility is the level to which the water will rise in the well (the static water level). Since water in the rock aquifers is under artesian pressure, the water rises in the well once it penetrates the aquifer. This rise in water level can reduce the cost of pumping. Average static water levels in Lee County wells are shown in Figures 10, 11, and 12.

Average yields and water quality characteristics throughout the county for each of the aquifers are also summarized in the maps in Figures 10, 11, 12, 13, 14, and 15.

Table 1

GEOLOGIC AND HYDROGEOLOGIC UNITS IN LEE COUNTY

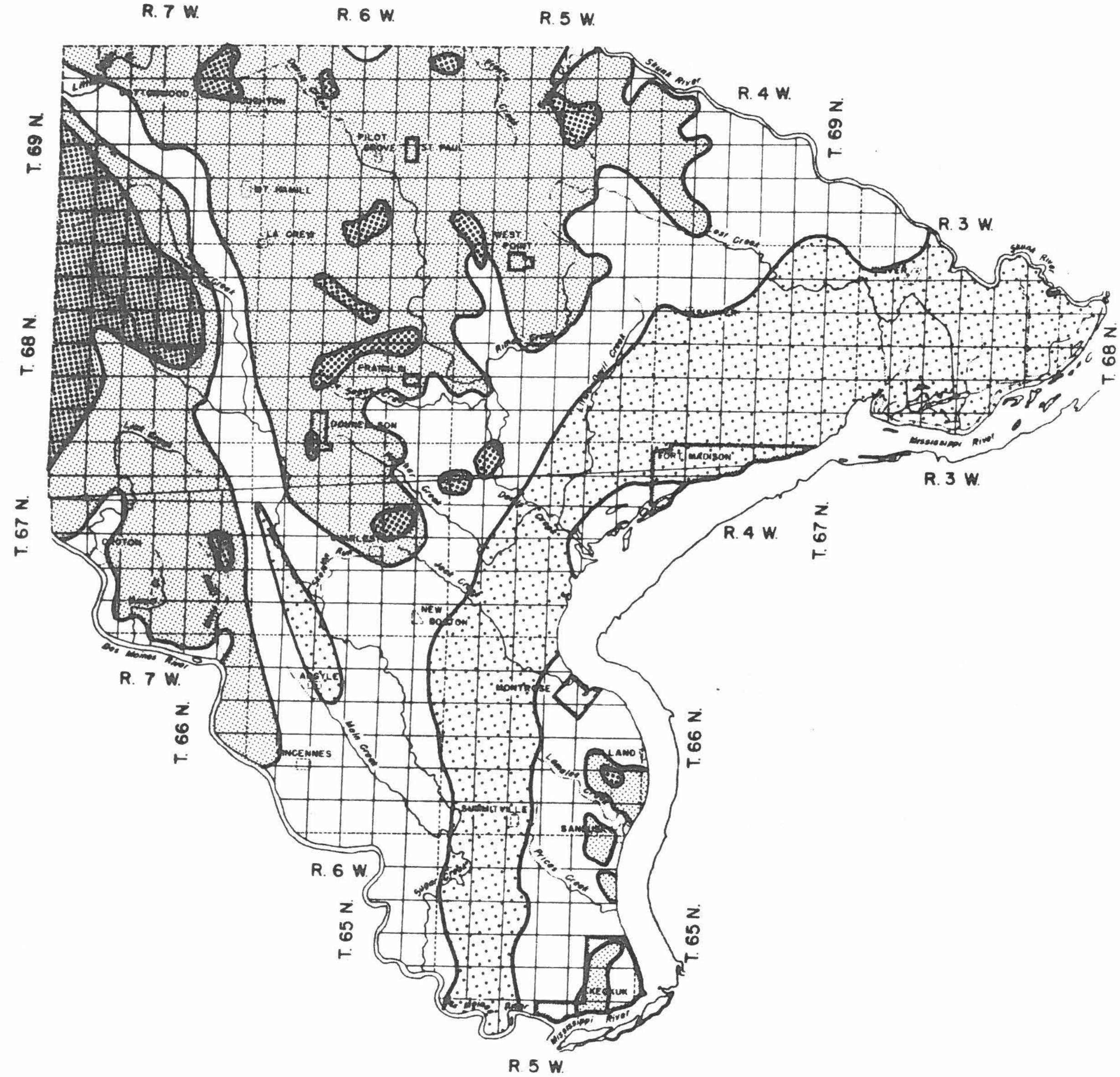
Age	Rock Unit	Description	Thickness Range	Hydrogeologic Unit	Water-Bearing Characteristics
Quaternary	Alluvium	Sand, gravel, silt and clay	0 - 350 (feet)	Surficial aquifer	Fair to large yield (25 to 100 gpm)
	Glacial Drift (undifferentiated)	Predominantly till containing scattered irregular bodies of sand and gravel			Low yields (less than 10 gpm)
	Buried channel deposits	Sand, gravel, silt and clay			Small to large yields
Pennsylvanian	Des Moines Series	Shale, sandstones, and limestones; mostly thin	0 - 75	Aquiclude	Does not yield water
Mississippian	Meramec Series	Sandy limestone	0 - 400	Mississippian aquifer	Fair to low yields
	Osage Series	Limestone and dolostone cherty; shale			
	Kinderhook Series	Limestone, oolitic and dolostone, sherty; also siltstone			
Devonian	Maple Mill Shale Sheffield Formation Lime Creek Formation	Mostly shale, with siltstone in the upper part and limestone in the lower part	200 - 300	Devonian aquiclude	Does not yield water
	Cedar Valley Limestone Wapsipinicon Formation	Limestone and dolostone contains evaporites (gypsum), in southern half of Iowa	100 - 175	Devonian aquifer	Fair to low yields
Ordovician	Galena Formation	Dolostone and chert	900 - 1050	Minor aquifer	Low yields
	Decorah Formation-Platteville Formation	Limestone, dolostone and thin shale, includes sandstone in SE Iowa		Aquiclude	Does not yield water
	St. Peter Sandstone	Sandstone		Cambrian-Ordovician aquifer	Fair yields
	Prairie du Chien Formation	Dolostone; sandy and cherty			High yields (over 500 gpm)
Cambrian	Jordan Sandstone	Sandstone	40 - 60		
	St. Lawrence Formation	Dolostone		Aquitard	Does not yield water
	Franconia Sandstone	Sandstone and shale			
	Dresbach Group	Sandstone		Dresbach aquifer	High to low yields *
Precambrian	Undifferentiated	Coarse sandstones; crystalline rocks		Base of groundwater reservoir	Not known to yield water

* highly mineralized in Lee County

Figure 2
SURFICIAL MATERIALS

Figure 3

GEOLOGIC MAP



Pennsylvanian Aquiclude

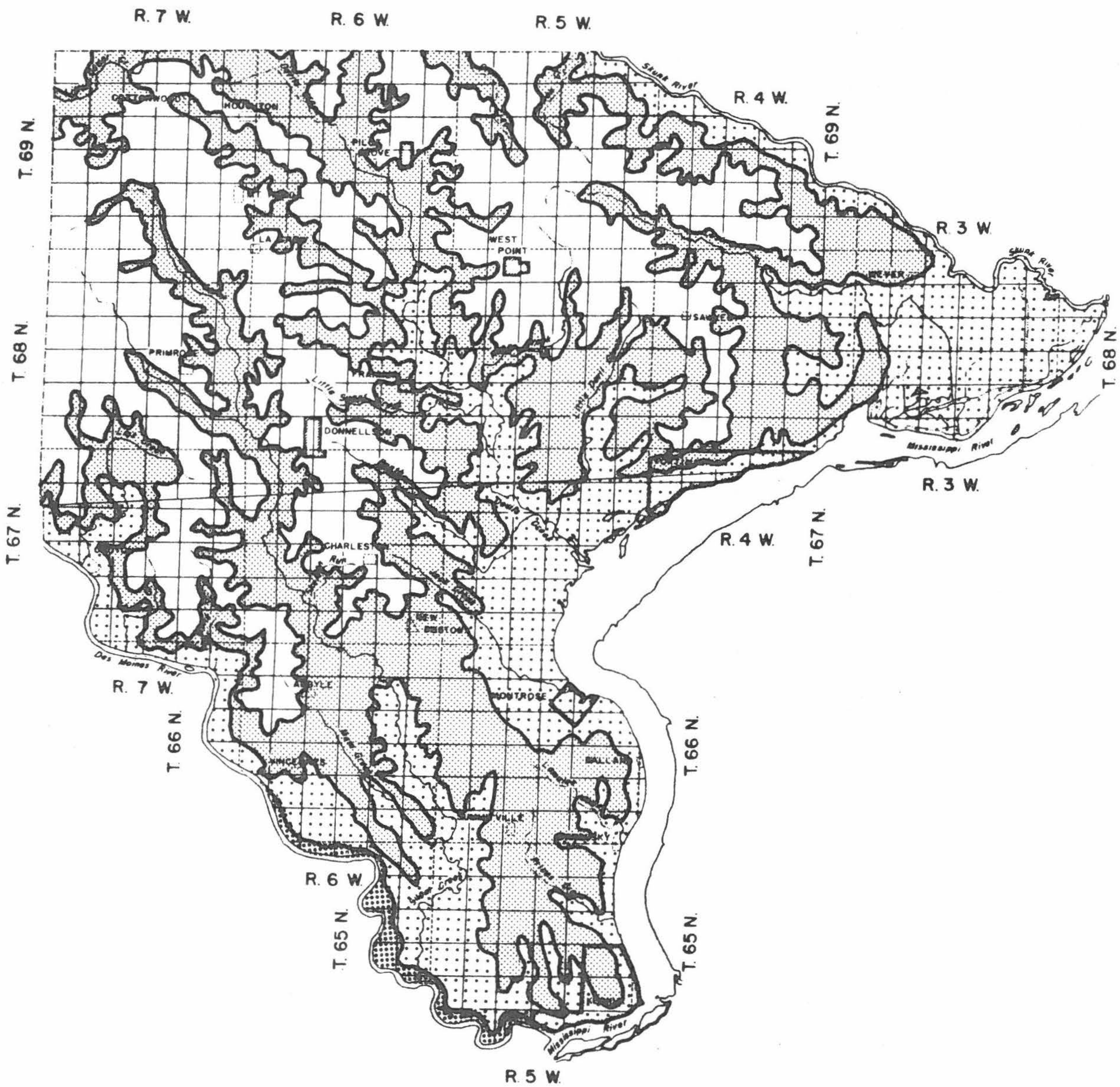
Mississippian Aquifer-upper part

Mississippian Aquifer-lower part

Mississippian-Devonian aquiclude

Figure 4

ELEVATION OF LAND SURFACE IN FEET ABOVE MEAN SEA LEVEL



Below 500 feet	600-700 feet
500-600 feet	Above 700 feet

Figure 5

ELEVATION OF BEDROCK SURFACE IN FEET ABOVE MEAN SEA LEVEL

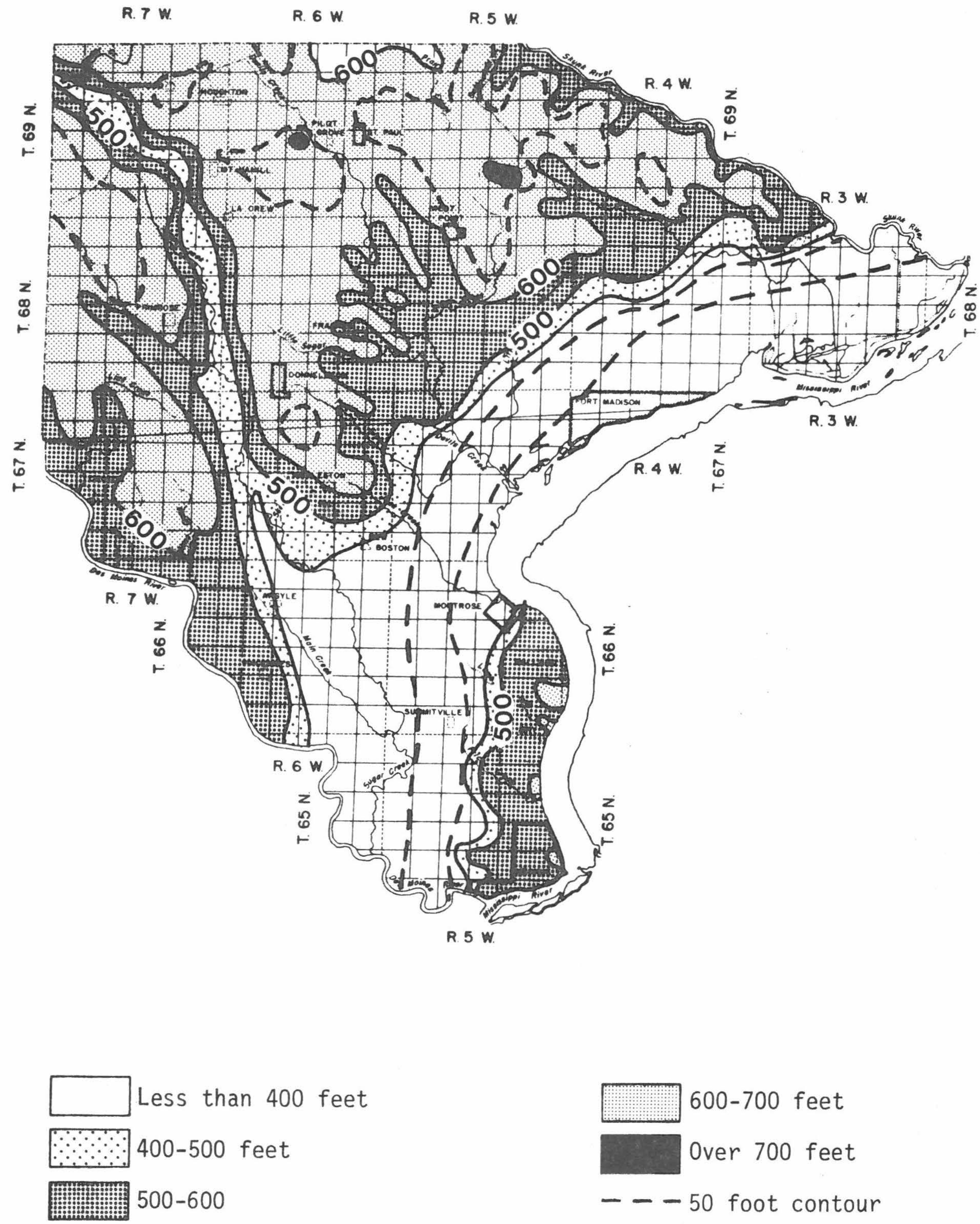


Figure 6

RANGE IN DEPTH TO LEE COUNTY'S PRINCIPAL ROCK AQUIFERS

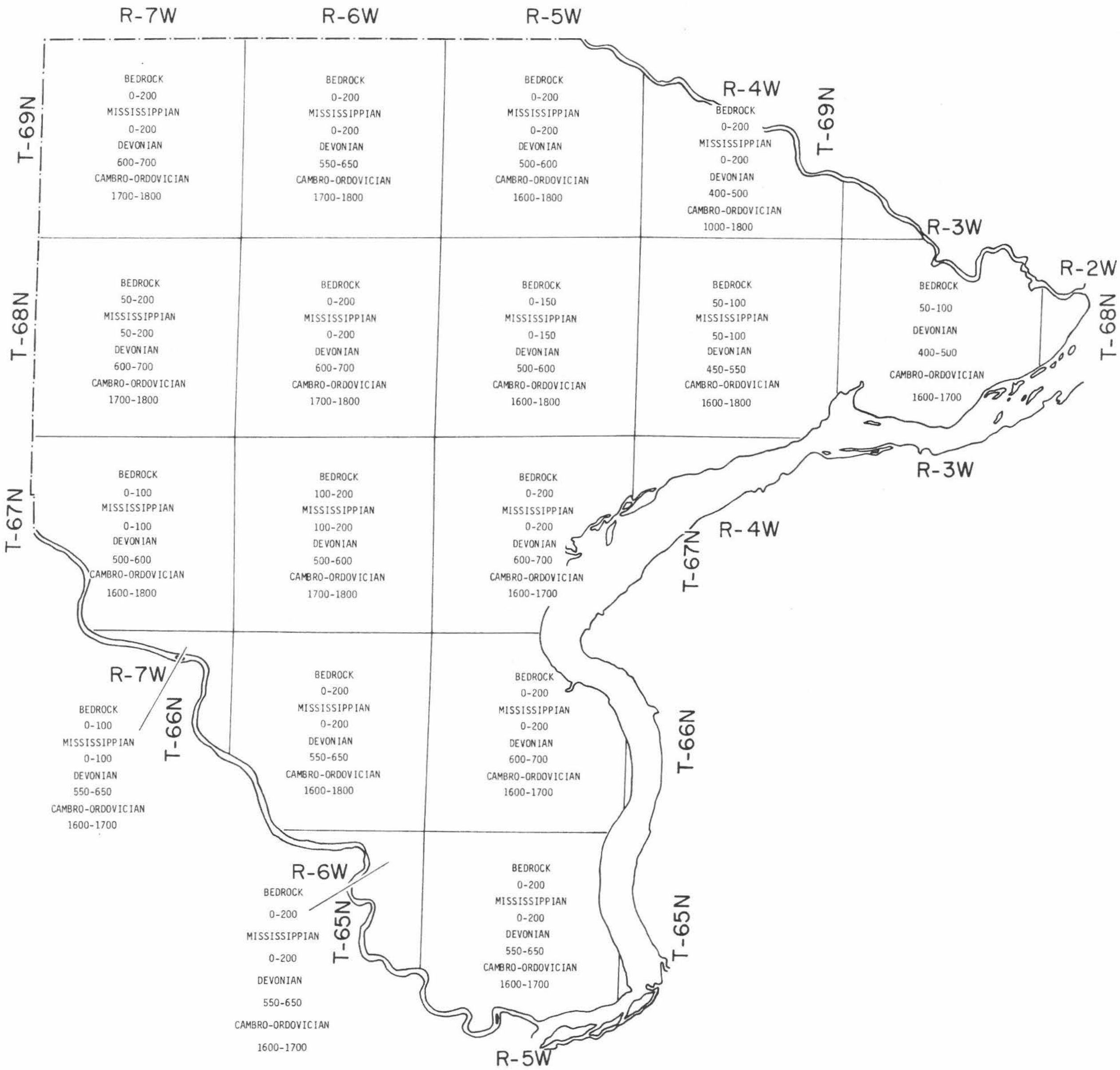


Figure 7

INDEX MAP FOR TYPICAL WELLS IN LEE COUNTY

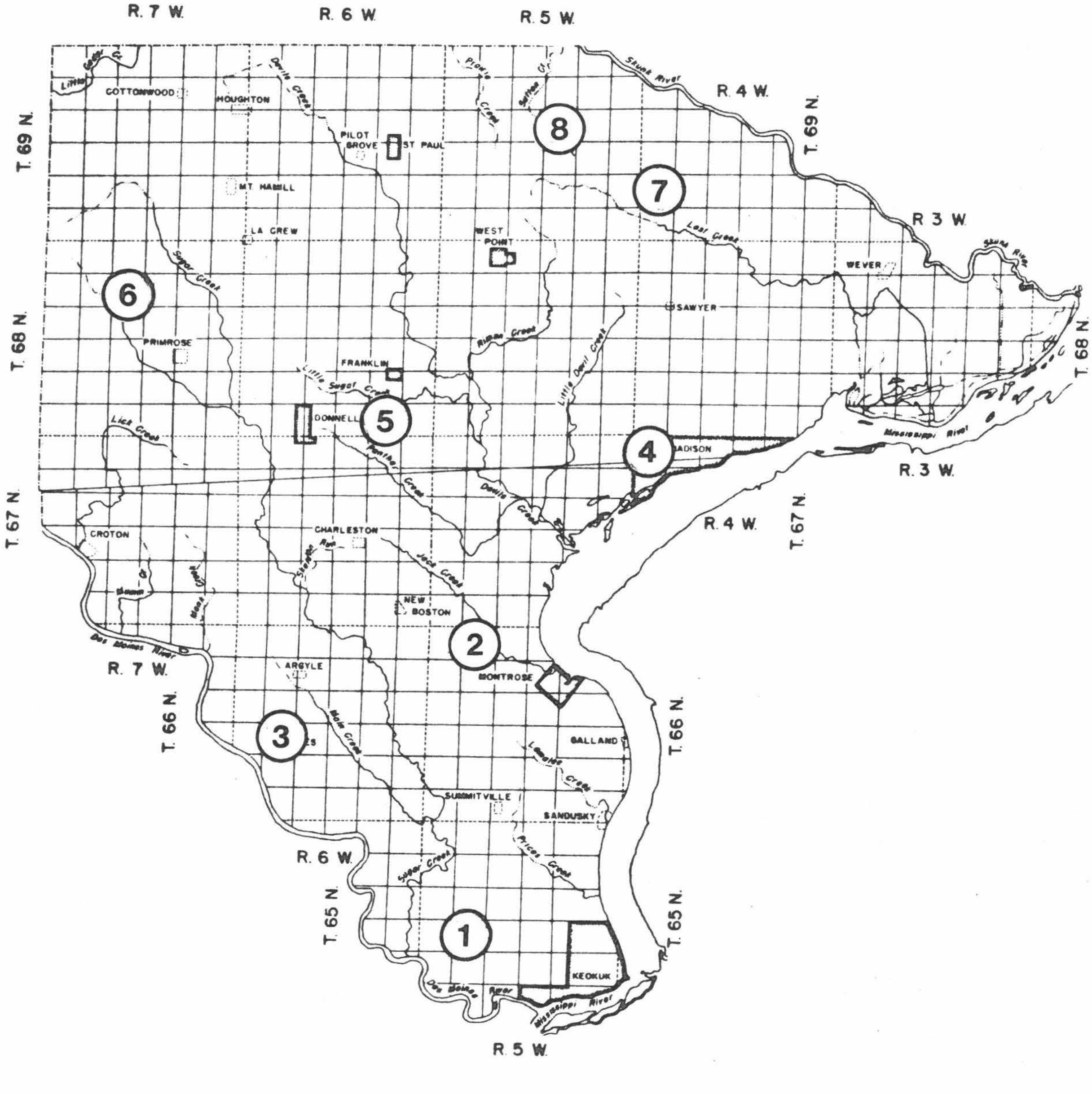


Figure 8

TYPICAL WELLS IN LEE COUNTY

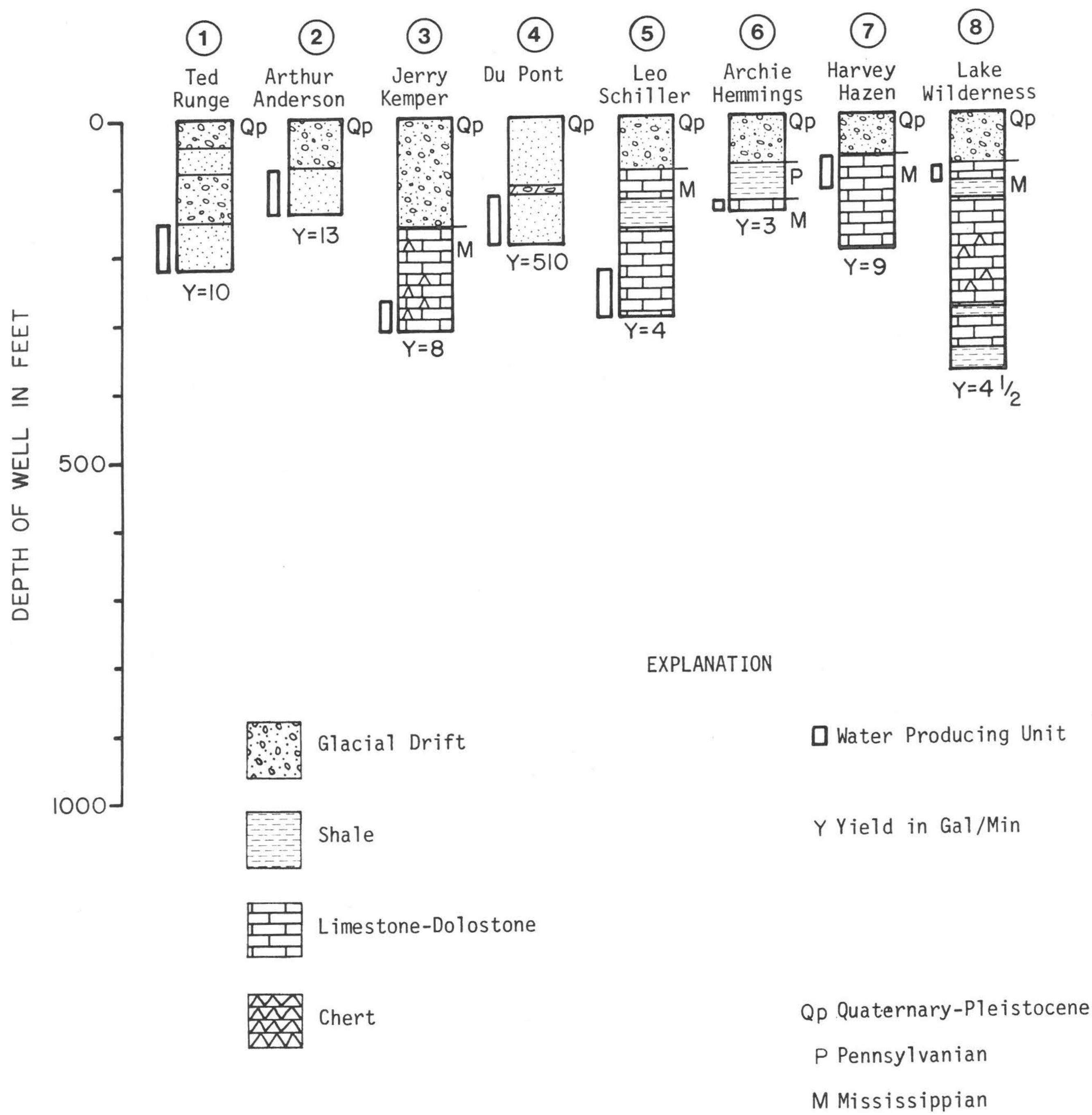
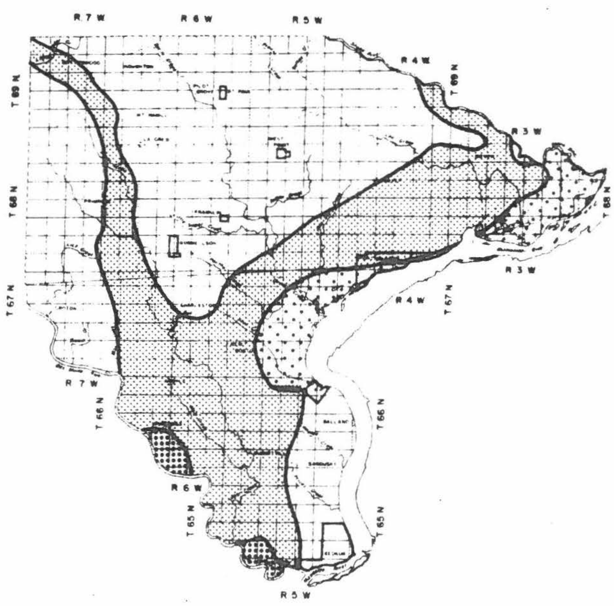


Figure 9
SURFICIAL AQUIFERS

Water Levels

Water levels in the surficial aquifers are difficult to analyze, water rises to different levels in wells drilled into alluvial, buried-channel, and drift aquifers. The water table in the drift aquifer generally slopes from high land areas toward the streams and, changes noticeably throughout the year. Levels in drift and buried-channel aquifers respond rapidly to recharge from precipitation. Water levels in the alluvial aquifer fluctuates somewhat in the same way as those in the drift and buried-channel aquifers; however, the main influence on the alluvial aquifer is the stage (level) of the associated streams. Water levels will be high during periods of high stream stage and low during the low-stage periods.

Water levels in the drift aquifers commonly are from 10 to 50 feet below the land surface, and those in the buried-channel aquifers have been reported to be as low as 175 feet below the land surface. The water levels in alluvial wells are from 4 to 20 feet below the flood-plain surface and the depth to the water surface will be accordingly deeper in wells located on terrace surfaces.



Water yields to wells in gallons per minute

Below 20

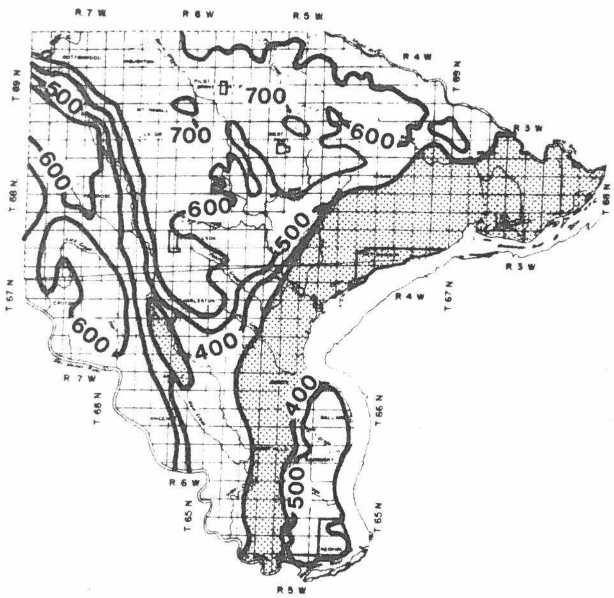
20-100

100-500

More than 500

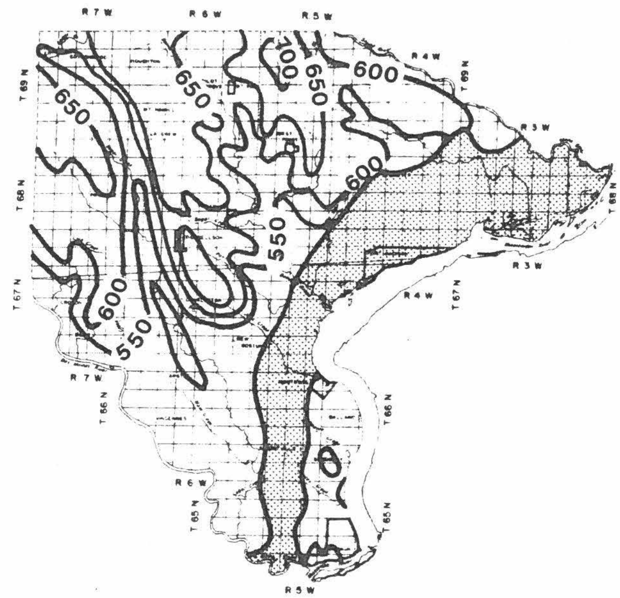
Figure 10

MISSISSIPPIAN AQUIFER



Elevation of top of the Mississippian aquifer, in feet above mean sea level

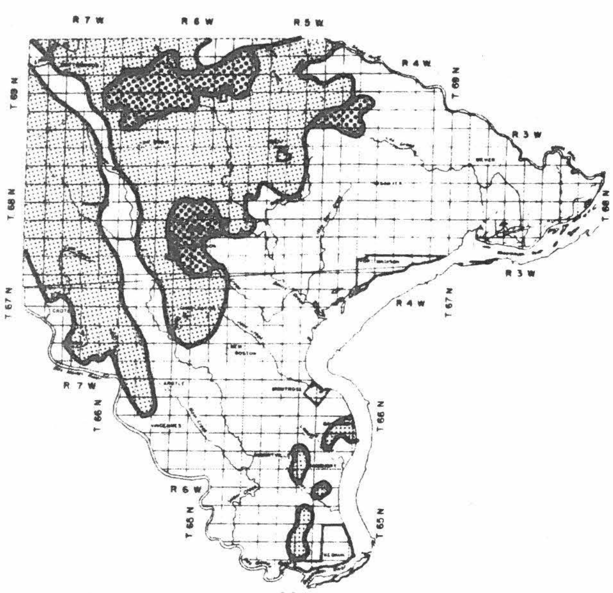
Mississippian aquifer absent



Water levels in wells in feet above mean sea level

Aquifer not present

Upper Part

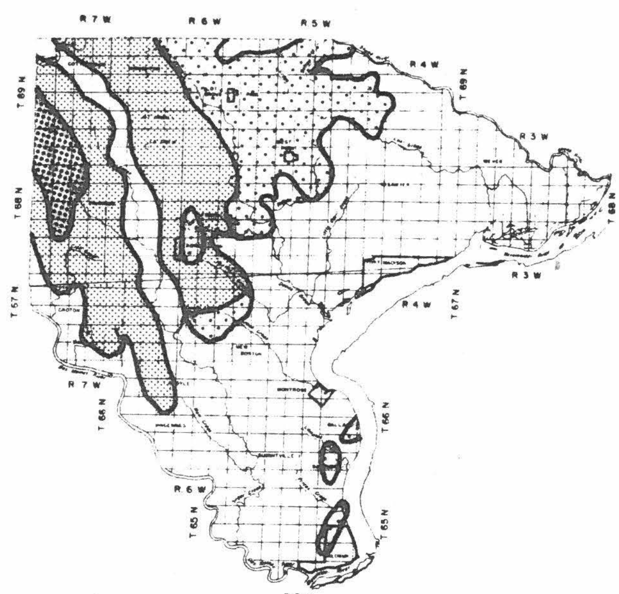


Water yields to wells in gallons per minute

Below 20

20-50

Aquifer not present



Dissolved solids content in milligrams per liter (mg/l)*

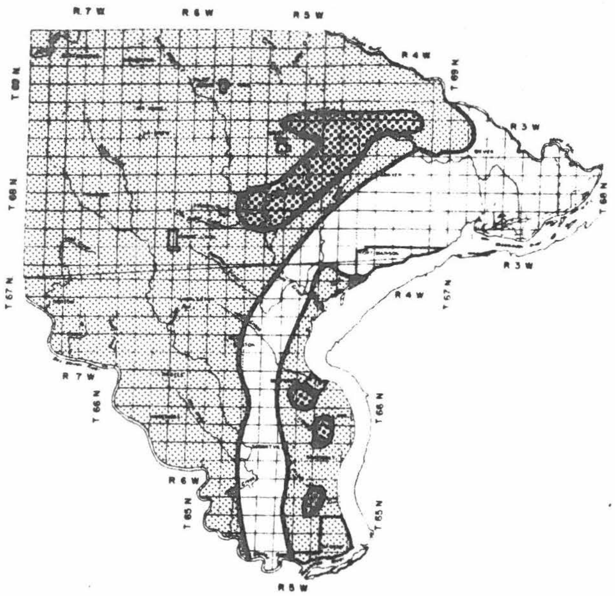
Less than 500

500-1000

1000-2500

Aquifer not present

*Other water quality data in Figure 13

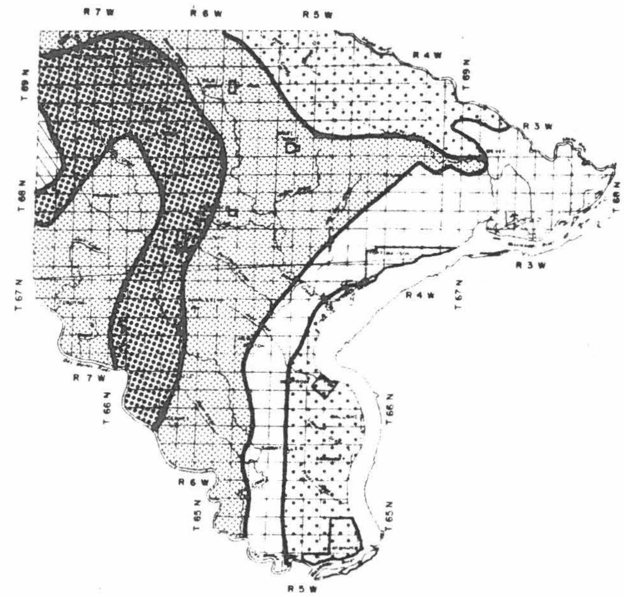


Water yields to individual wells, in gallons per minute.

Less than 20

20-50

Aquifer not present



Dissolved-solids content of water, in milligrams per liter (mg/l)*

Less than 500

500-1000

1000-2500

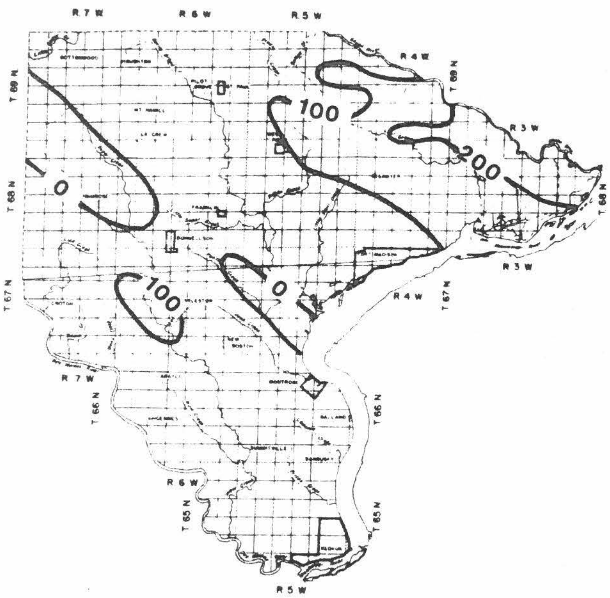
2500-5000

Aquifer not present

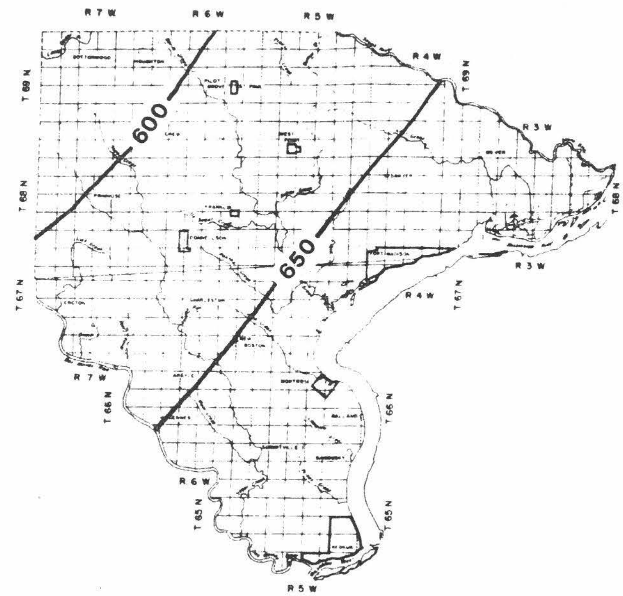
*Other water quality data in Figure 14

Figure 11

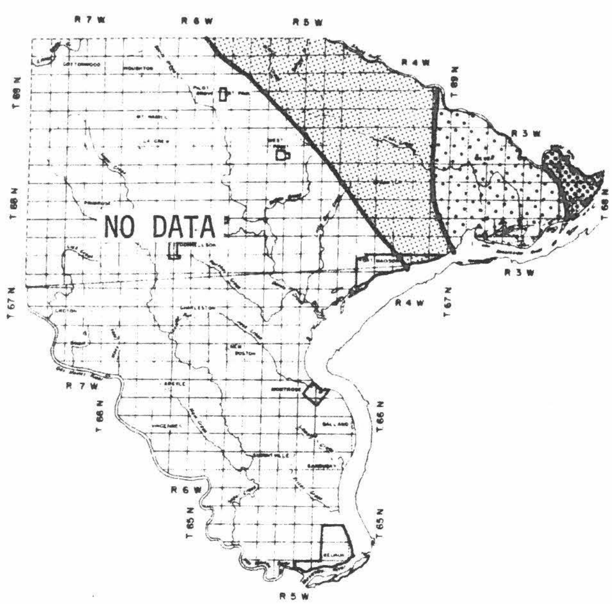
DEVONIAN AQUIFER



Elevation of Devonian Aquifer in feet above mean sea level



Water levels in wells in feet above mean sea level

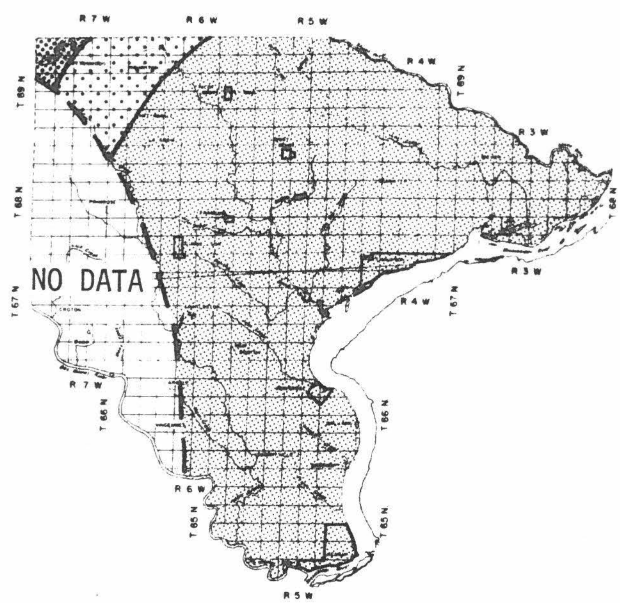


Water yields to wells in gallons per minute

Below 20

20-50

More than 50



Dissolved solids content in milligrams per liter (mg/1)*

2500-5000

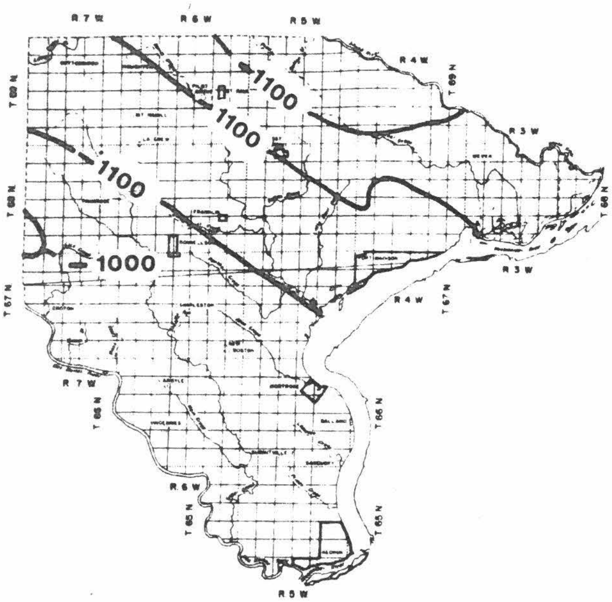
5000-7500

7500-10,000

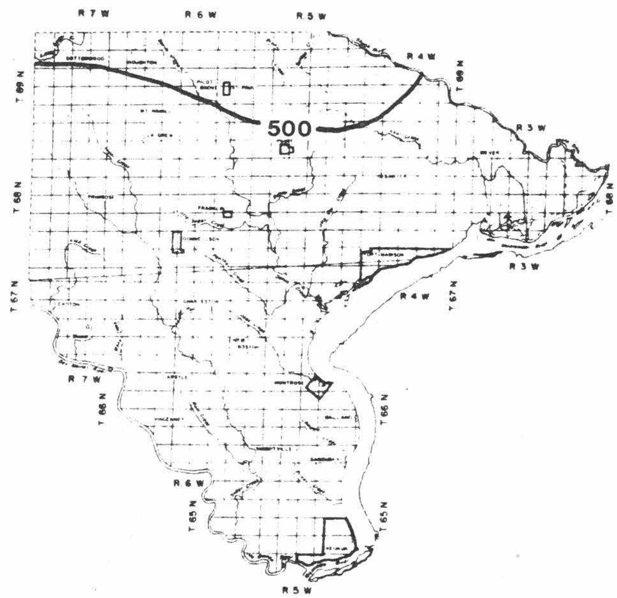
*Other water quality data in Figure 15.

Figure 12

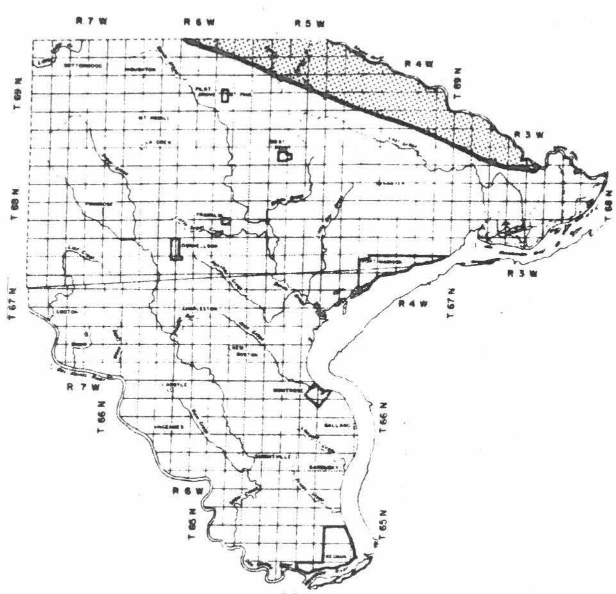
CAMBRO-ORDOVICIAN (JORDAN) AQUIFER



Elevation of the Jordan aquifer in feet above sea level



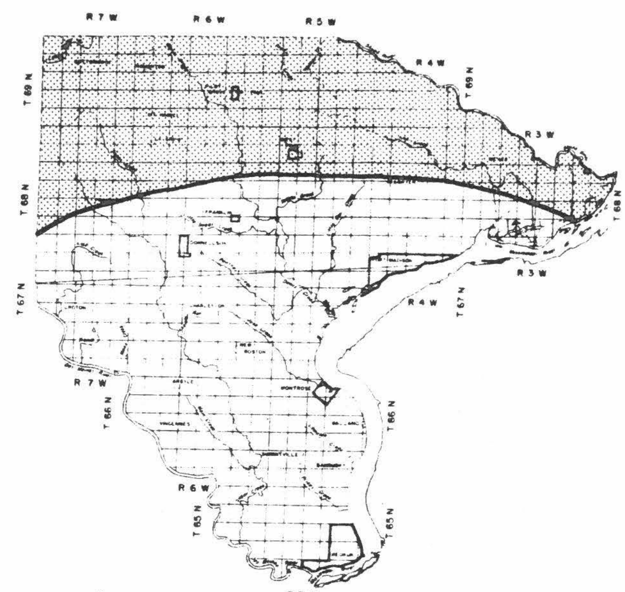
Water levels in wells in feet above mean sea level



Water yields to wells in gallons per minute

☐ 500-1000

▒ More than 1000



Dissolved solids content in milligrams per liter (mg/1)*

▒ 1000-1500

☐ greater than 1500

*Other water quality data in Figure 15

Table 2

SIGNIFICANCE OF MINERAL CONSTITUENTS AND PHYSICAL PROPERTIES OF WATER

Constituent or Property	Maximum Recommended Concentration	Significance
Iron (Fe)	0.3 mg/l	Objectionable as it causes red and brown staining of clothing and porcelain. High concentrations affect the color and taste of beverages. Iron is not listed in the following tables, as there are often major differences between reported and actual concentrations. It may be added to water from well casings, pumps, and pipes. The concentration also is affected by micro-organisms. Special sampling and analytical techniques are needed for accurate study.
Manganese (Mn)	0.05 mg/l	Objectional for the same reason as iron. When both iron and manganese are present, it is recommended that the total concentration not exceed 0.3 mg/l. Micro-organisms also affect the concentration. Special techniques are needed for an accurate study.
Calcium (Ca) and Magnesium (Mg)		Principal causes for hardness and scale-forming properties of water. They reduce the lathering ability of soap.
Sodium (Na) and Potassium (K)		Impart a salty or brackish taste when combined with chloride. Sodium salts cause foaming in boilers.
Sulfate (SO_4)	250 mg/l	Commonly has a laxitive effect when the concentration is 600 to 1,000 mg/l, particularly when combined with magnesium or sodium. The effect is much less when combined with calcium. This laxitive effect is commonly noted by newcomers, but they become acclimated to the water in a short time. The effect is noticeable in almost all persons when concentrations exceed 750 mg/l. Sulfate combined with calcium forms a hard scale in boilers and water heaters.
Chloride (Cl)	250 mg/l	Large amounts combined with sodium impart a salty taste.
Fluoride (F)	2.0 mg/l	Concentrations of 0.8 to 1.3 mg/l are considered to play a part in the reduction of tooth decay. However, concentrations over 2.0 mg/l will cause the mottling of the enamel of children's teeth.
Nitrate (NO_3)	45 mg/l	Waters with high nitrate content should not be used for infant feeding as it may cause methemoglobinemia or cyanosis. High concentrations suggest organic pollution from sewate, decayed organic matter, nitrate in the soil, or chemical fertilizer. High nitrates in the natural waters of central Iowa are limited to isolated occurrences, usually from shallow dug wells on farms. Since the high concentrations are characteristic of individual wells and not of any one aquifer, nitrate will not be discussed in this report.
Dissolved Solids	500 mg/l	This refers to all of the material in water that is in solution. If affects the chemical and physical properties of water for many uses. Amounts over 2,000 mg/l will have a laxitive effect on most persons. Amounts up to 1,000 mg/l are generally considered acceptable for drinking purposes if no other water is available.
Hardness (as $CaCO_3$)		This affects the lathering ability of soap. It is generally produced by calcium and magnesium. Hardness is expressed in parts per million equivalent to $CaCO_3$ as if all the hardness were caused by this compound. Water becomes objectionable for domestic use when the hardness is above 100 mg/l; however, it can be treated readily by softening.
Temperature		Affects the desirability and economy of water use, especially for industrial cooling and air conditioning. Most users want a water with a low and constant temperature.
Suspended Sediment		Causes water to have a cloudy or muddy appearance. It must be settled or filtered out before the water is used. It is the material that "silts-up" reservoirs, and it is the major cause of the reduction of reservoir life.

To the user, the quality of ground water is as important as the amount of water that an aquifer will yield. As ground water moves through soil and rock materials, it dissolves some of the minerals which, in turn, affect water quality. In addition to mineral content, bacterial and chemical contamination may be introduced through poorly constructed wells and seepage from other pollution sources.

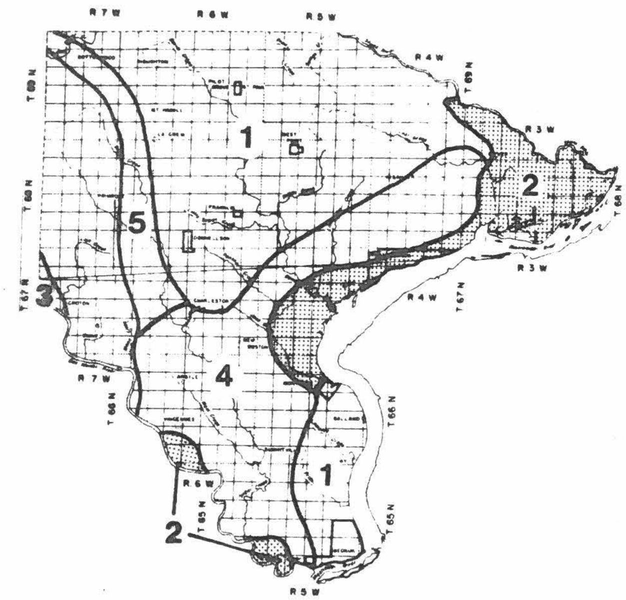
Recommended standards for common water constituents are described in the table above. These are rationally accepted as guidelines for acceptable drinking water supplies. Limits for uses other than drinking often differ from these. For instance, water that is unacceptable for drinking and household use may not be completely satisfactory for industrial cooling.

From analyses of ground water averages (A) and ranges (R) of values in milligrams per liter (mg/l) for several constituents are summarized in Tables 3 and 4 for the surficial and bedrock aquifers in Lee County. Recommended concentrations for some constituents are often exceeded with obvious ill effects, although the water may be unpalatable. Water quality analyses for individual wells should be obtained to determine if concentrations of constituents that affect health are exceeded.

Figure 13

CHEMICAL CHARACTER OF GROUND WATER

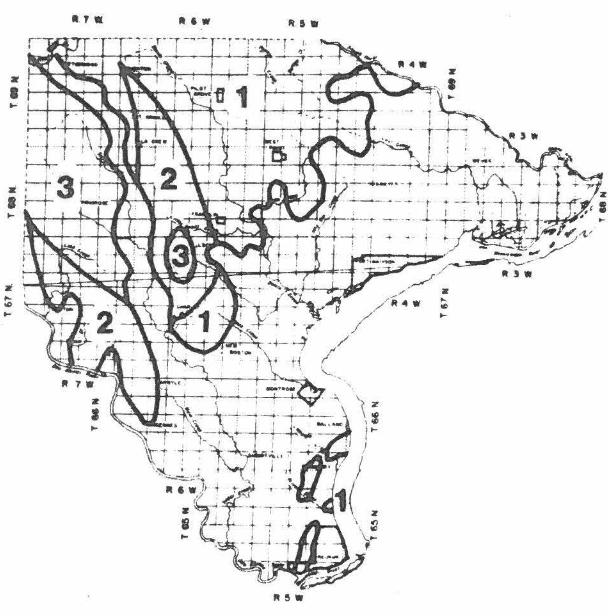
Surficial Aquifers



Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
					Drift Aquifer					
1	A	103	36	40	506	74	2.7	0.4	547	406
	R	77-150	24-61	13-88	304-739	11-393	0.5-7.5	0.2-0.7	357-982	292-625
					Alluvial Aquifer					
2	A	66	19	15	272	39	8	0.3	306	243
	R	41-85	11-29	7.2-56	149-407	8.2-113	.5-31	.2-1.0	221-436	168-330
3	A	108	31	21	295	169	11	.4	552	395
	R	84-143	20-41	11-28	218-390	22-287	3.5-17	0-1.0	440-726	304-525
					Buried Channel Aquifer					
4	A	96	32	45	499	49	7.8	.2	501	374
	R	55-135	17-49	3.5-133	305-673	.1-140	.5-36	0-.6	311-676	259-489
5	A	53	20	153	579	46	12	.4	591	215
	R	24-88	3.1-39	87-244	410-803	.2-170	2.5-28	0-1.0	357-715	78-360

Surficial aquifers yield the least mineralized and best quality ground water in Lee County. The water from the buried channel aquifers is often more mineralized than water from the other surficial aquifers, because of their close association with bedrock aquifers. Water temperatures average 54°F (12.0°C) and range from 48°F to 58°F. (9.0°C to 14.5°C).

Mississippian Aquifer
Upper Part



Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
					Upper Part of the Mississippian Aquifer					
1	A	104	32	43	472	91	4.5	0.4	537	399
	R	66-156	19-50	8.8-118	322-802	5.8-240	0.5-24	0-1.8	345-737	315-545
2	A	155	46	84	423	397	9.9	.6	955	578
	R	104-210	21-61	8-177	349-498	321-480	.5-35	0-1.8	793-1050	385-660
3	A	299	92	125	281	1100	8.5	.8	1950	1130
	R	197-547	47-124	33-214	44-434	750-1590	2-22	.3-1.6	1420-2740	723-1560

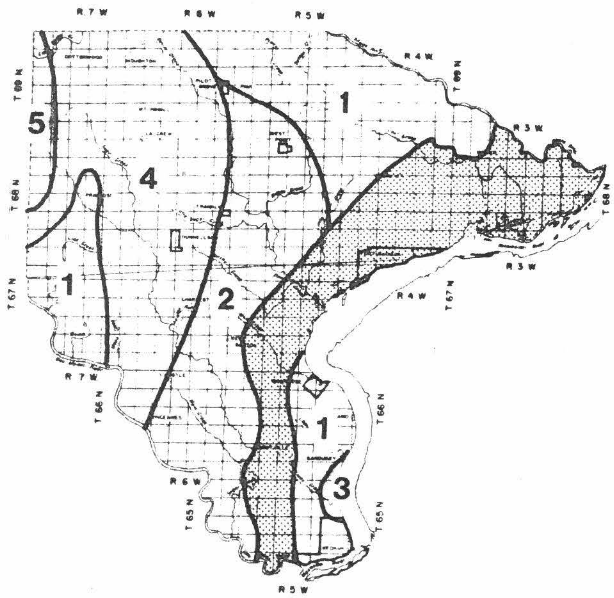
Good to fair water quality is available in the upper part of the Mississippian in areas 1 and 2, poor in area 3. The water is more highly mineralized than that found in the surficial aquifers and is usually hard. Average water temperature is 55°F (13°C) and ranges from 51°F to 60°F(10.5°C to 15.5°C).

Aquifer not present

Figure 14

Mississippian Aquifer

Lower Part



Aquifer not present

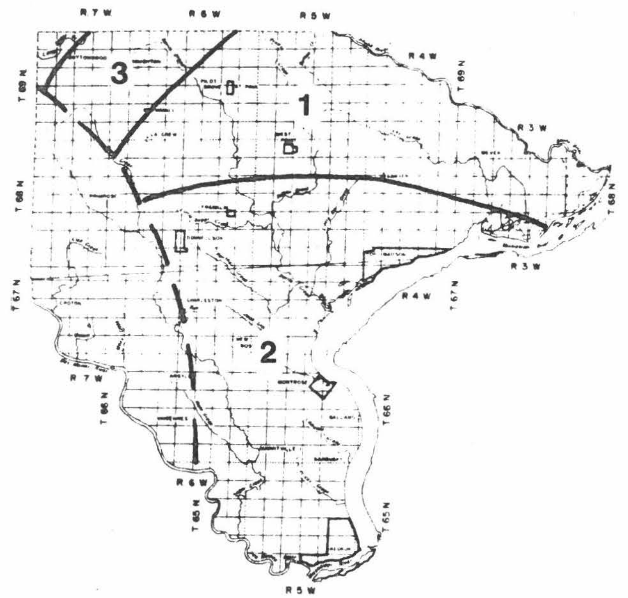
Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
Lower Part of the Mississippian Aquifer										
1	A	90	37	42	504	46	6	0.4	490	380
	R	30-160	10-61	9-107	298-710	1-186	0-69	0.1.2	280-800	160-575
2	A	42	20	117	453	57	14	.9	477	190
	R	22-70	12-35	55-195	344-551	1-160	.5-57	0.5-1.5	281-677	102-317
3	A	194	113	48	462	586	28	.2	1340	946
	R	189-198	102-124	33-64	407-517	568-604	20-37		1250-1420	892-1000
4	A	78	38	276	592	354	57	1.6	1110	355
	R	38-128	19-68	143-489	465-754	260-560	.5-150	.5-2.5	879-1480	176-581
5	A	102	52	718	459	1340	169	2.6	2710	469
	R	35-193	15-107	451-994	266-595	920-1660	19-365	5-6	2220-3250	148-891

Water in the lower part of the Mississippian Aquifer is generally of poorer quality than found in the upper part. Throughout the county the water is exceptionally hard. Areas 3, 4 and 5, have high concentrations of dissolved solids and sulfates. Area 5 also has a high chloride content. Areas 1 and 2 have the best quality water for the lower Mississippian aquifer of Lee County. The average water temperature is 55°F (13°C), and ranges from 51°F to 60°F (10.5°C to 15.5°C).

Figure 15

CHEMICAL CHARACTER OF GROUND WATER

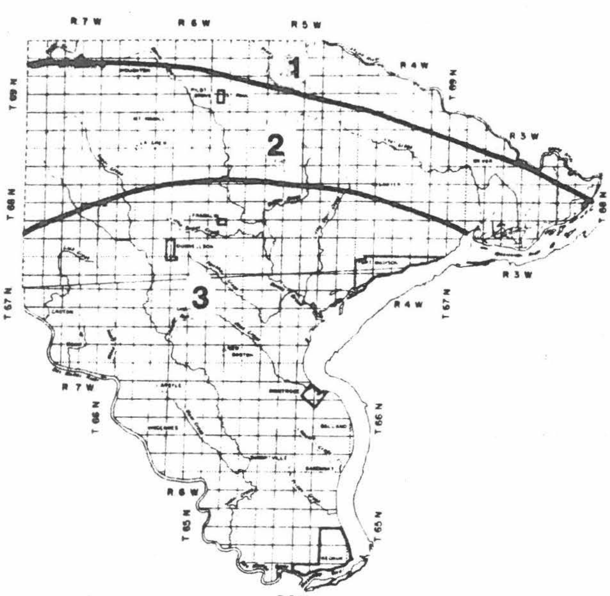
Devonian Aquifer



Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
1	A	333	111	485	282	1770	218	2.1	3310	1290
	R	246-378	79-145	412-539	244-305	1470-2070	205-235	1.0-3.0	2900-3800	942-1540
2	A	187	82	813	301	1490	690		3860	810
3	A	359	116	1500	342	3450	516	2.4	6340	1380
	R	180-532	75-157	1330-1630	303-388	2200-4000	400-810	1.7-4.2	5050-6900	760-1870

Water from the Devonian aquifer in Lee County is typically highly mineralized and is of very poor quality. It is generally high in sulfate, sodium, iron, manganese, and dissolved solids. Water temperatures are higher than for the Mississippian aquifer, averaging 60°F (15.5°C) and ranging from 54°F to 64°F (12.0°C to 18.0°C).

Cambro-Ordovician Aquifer



Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
1	A	84	34	267	298	476	124	1.7	1160	349
	R	78-92	26-41	247-283	283-317	455-500	100-148	1.0-2.2	1100-1220	322-388
2	A	71	30	322	304	394	216	2.4	1210	300
	R	65-76	25-32	310-331	273-326	338-420	209-222	2.0-2.9	1080-1310	290-321
3	A	97	39	430	300	440	440	3.2	1650	403

This deep aquifer yields water of fair quality. However, it is noticeably hard and exceeds recommended standards for sulfates and dissolved solids. Water temperatures are higher than for other rock aquifer sources, averaging 72°F (22°C) and ranging from 68°F to 76°F (20.0°C to 24.5°C).

RECOMMENDATIONS FOR PRIVATE WATER WELLS

Contracting for Well Construction

To protect your investment and guarantee satisfactory well completion, it is a good idea to have a written agreement with the well driller. The agreement should specify in detail:

size of well, casing specifications, and types of screen and well seal

methods of eliminating surface and subsurface contamination

disinfection procedure to be used

type of well development if necessary

test pumping procedure to be used

date for completion

itemized cost list including charges for drilling per foot, for materials per unit, and for other operations such as developing and test pumping

guarantee of materials, workmanship, and that all work will comply with current recommended methods

liability insurance for owner and driller

Well Location

A well should be located where it will be least subject to contamination from nearby sources of pollution. The Iowa State Department of Health recommends minimum distances between a new well and pollution sources, such as cesspools (150 ft.), septic tanks (50 ft.), and barnyards (50-100 ft. and down slope from well). Greater distances should be provided where possible.

The well location should not be subject to flooding or surface water contamination. Select a well-drained site, extend the well casing a few feet above the ground, and mound earth around it. Diversion terraces or ditches may be necessary on slopes above a well to divert surface runoff around the well site.

In the construction of all wells care should be taken to seal or grout the area between the well bore and the well casing (the annulus) as appropriate so that surface water and other pollutants cannot seep into the well and contaminate the aquifer.

Water Treatment

Water taken from a private well should ideally be tested every six months. The University Hygienic Laboratory will do tests for coliform bacteria, nitrate, iron, hardness, and iron bacteria in drinking water for private individuals. Special bottles must be used for collecting and sending water samples to the laboratory. A sample kit can be obtained by writing to the University Hygienic Laboratory, University of Iowa, Oakdale Campus, Iowa City, Iowa 52242. Indicate whether your water has been treated with chlorine, iodine, or bromine; as different sample bottles must be used for treated and untreated water. The charge for the bacterial test is $3.00; for iron, hardness, and nitrate, it is $3.00; and for iron bacteria, $5.00. If your well is determined to be unsafe, advice for correcting the problem can be obtained from your county or state Department of Health. Several certified private laboratories also run water analyses.

Shock chlorination is recommended following the construction and installation of a well and distribution system and any time these are opened for repairs or remodeling. A strong chlorine solution is placed in the well and complete distribution system to kill nuisance and disease-causing organisms. If the first shock chlorination does not rid the water supply of bacteria, it should be repeated, if this does not solve the problem the well should be abandoned or the water should be continuously disinfected with proper chlorination equipment.

Since most of the ground waters in Lee County are mineralized, water softening and iron removal equipment may make water more palatable and pleasant to use. Softened water contains increased sodium; contact your physician before using a softener if you are on a sodium-restricted diet. Chlorination followed by filtration will remove most forms of iron and iron bacteria. Iron bacteria has no adverse effect on health but will plug wells, water lines, and equipment and cause tastes and odors. Iron removal equipment can be used if problems persist.

Well Abandonment

Wells taken out of service provide easy access for pollution to enter aquifers supplying water to other wells in the vicinity. Unprotected wells may also cause personal injury. Proper abandonment procedures should be followed to restore conditions to those that existed before the well was constructed, and to prevent source contamination. Permanent abandonment requires careful sealing. The well should be filled with concrete, cement grout, or sealing clays throughout its entire length. Before dug or bored wells are filled at least the top 10 feet of lining should be removed so surface waters will not penetrate the subsurface through a porous lining or follow cracks in or around the lining. The site should be completely filled and mounded with compacted earth.

ABANDONED WELLS SHOULD NEVER BE USED FOR DISPOSAL OR SEWAGE OR OTHER WASTES.

SOURCES OF ADDITIONAL INFORMATION

In planning the development of a ground water supply or contracting for the drilling of a new well additonal or more specific information is often required. This report section lists several sources and types of additional information.

State Agencies That May Be Consulted

Iowa Geological Survey[1]	123 North Capitol Iowa City 52242	(319) 338-1173
State Health Department[2,6]	Lucas Building Des Moines 50319	(515) 281-5787
Iowa Natural Resources Council[3]	Wallace Building Des Moines 50319	(515) 281-5914
Iowa Dept. of Environ. Quality[4]	Wallace Building Des Moines 50319	(515) 281-8854
University Hygienic Laboratory[5]	U. of IA, Oakdale Campus Iowa City 52242	(319) 353-5990
Cooperative Extension Service in[6] Agriculture and Home Economics	110 Curtis Hall, ISU Ames 50011	(515) 294-4569

Functions:

[1] Geologic and ground water data repository, consultant on well prolblems, water development and related services.

[2] Drinking water quality, public and private water supplies.

[3] Water withdrawal regulation and Water Permits for well withdrawing more than 5000 gpd.

[4] Municipal supply regulation and well construction permits

[5] Water quality analysis

[6] Advice on water systems design and maintenance

Well Drillers and Contractors

The listing provided here was drawn from an Iowa Geological Survey mailing list, those selected here are within a radius of 50 miles of Lee County. For a state-wide listing contact either the Iowa Water Well Driller's Association, 4350 Hopewell Ave., Bettendorf, Iowa 51712, (319) 355-7528 or the Iowa Geological Survey

Bailey Well Co.
203 East Main
New London, Iowa 52645

Detrick Well Co.
R.R. #1
New London, Iowa 52645

Kramer Well Co.
Mt. Pleasant, Iowa 52641

Lyon Well Co.
Salem, Iowa 52649

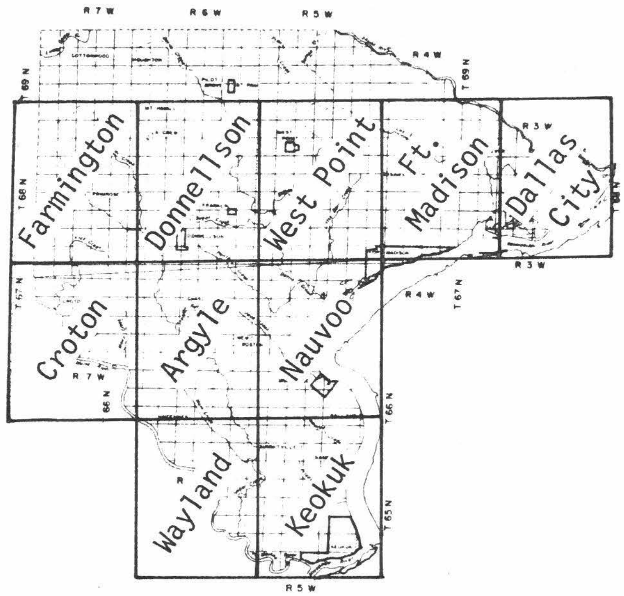
Schlicher Bros. Well
Hwy. 34 West
Fairfield, Iowa 52556

Schlicher Well Co.
P.O. Box 207
Donnelson, Iowa 52625

Schmeiser Well Co.
111 Hageman St.
Burlington, Iowa 52601

Wilson Well Co.
R.R. #3
Burlington, Iowa 52601

Topographic Maps (Available from the Iowa Geological Survey)



Map Title	Date	Scale	Contour Interval
Farmington	1968	1:24,000	10
Donnellson	1968	1:24,000	10
Ft. Madison	1964	1:24,000	10
Dallas City	1964	1:24,000	10
Croton	1968	1:24,000	10
Argyle	1968	1:24,000	10
Nauvoo	1964	1:24,000	10
Wayland	1949	1:24,000	10
Keokuk	1964	1:24,000	10

Useful Reference Materials

Coble, R.W., and Roberts, J.V., 1971, The water resources of Southeast Iowa, Iowa Geological Survey, Water Atlas No. 4.

Horick, P.J., and Steinhilber, W.L., 1973, Mississippian aquifer of Iowa, Iowa Geological Survey, Misc. Map Series No. 3.

Horick, P.J., and Steinhilber, W.L., 1978, Jordan aquifer of Iowa, Iowa Geological Survey, Misc. Map Series No. 6.

Iowa State Department of Health, 1971, Sanitary standards for water wells, State Department of Health, Environmental Engineering Service.

Van Eck, O.J, 1971, Optimal well plugging procedures, Iowa Geological Survey Public Information Circular No. 1.

Van Eck, O.J, 1978, Plugging procedures for domestic wells, Iowa Geological Survey, Public Information Circular No. 11.