GROUND WATER
RESOURCES

Wapello County

Open File Report 79-90 WRD

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GROUND-WATER RESOURCES OF WAPELLO COUNTY

Introduction

Approximately 56 percent of the residents of Wapello County rely on ground water as the source of their drinking water. It is estimated that the use of ground water in the county currently approaches 2.52 billion gallons per year. For comparison, this amount would provide each resident with 150 gallons of water a day during the year. Actually, few if any households use this much water, and the rather large annual per capita use reflects the greater water requirements of the county's industries, agribusinesses, and municipalities.

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 costs 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 Wapello 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 Wapello 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 dolostone. 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 Wapello 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, the Devonian, and the Cambro-Ordivician aquifers. 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. 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 thus may be easily contaminated by the infiltration of surface water.

The drift aquifer is the thick layer of clay to boulder size material 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 in many places does not yield much water. There are, however, lenses of 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 minimum water supplies for domestic wells.

The buried channel aquifer consists of stream alluvium of partially filled valleys that existed before the glacial period. The valleys were overridden by the glaciers and are now buried under glacial and 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 accessibility 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 the elevations at selected locations.

Rock Aquifers

Below the surficial materials is a thick sequence of layered rocks formed from deposits of rivers and shallow seas that have covered the state within the last 600 million years. The geologic map (Figure 3) shows the geologic units which form the top of this rock sequence. These rocks are Pennsylvanian in age and are mainly shales. Although the Pennsylvanian rocks usually act as an aquiclude, there are locally sandstone layers (particularly in the central area near Ottumwa and west central areas of the county) which supply small yields to domestic wells. The thickness of the Pennsylvanian rocks varies from about 150' in the vicinity of Ottumwa to 0 to 10' in the western part of the county.

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

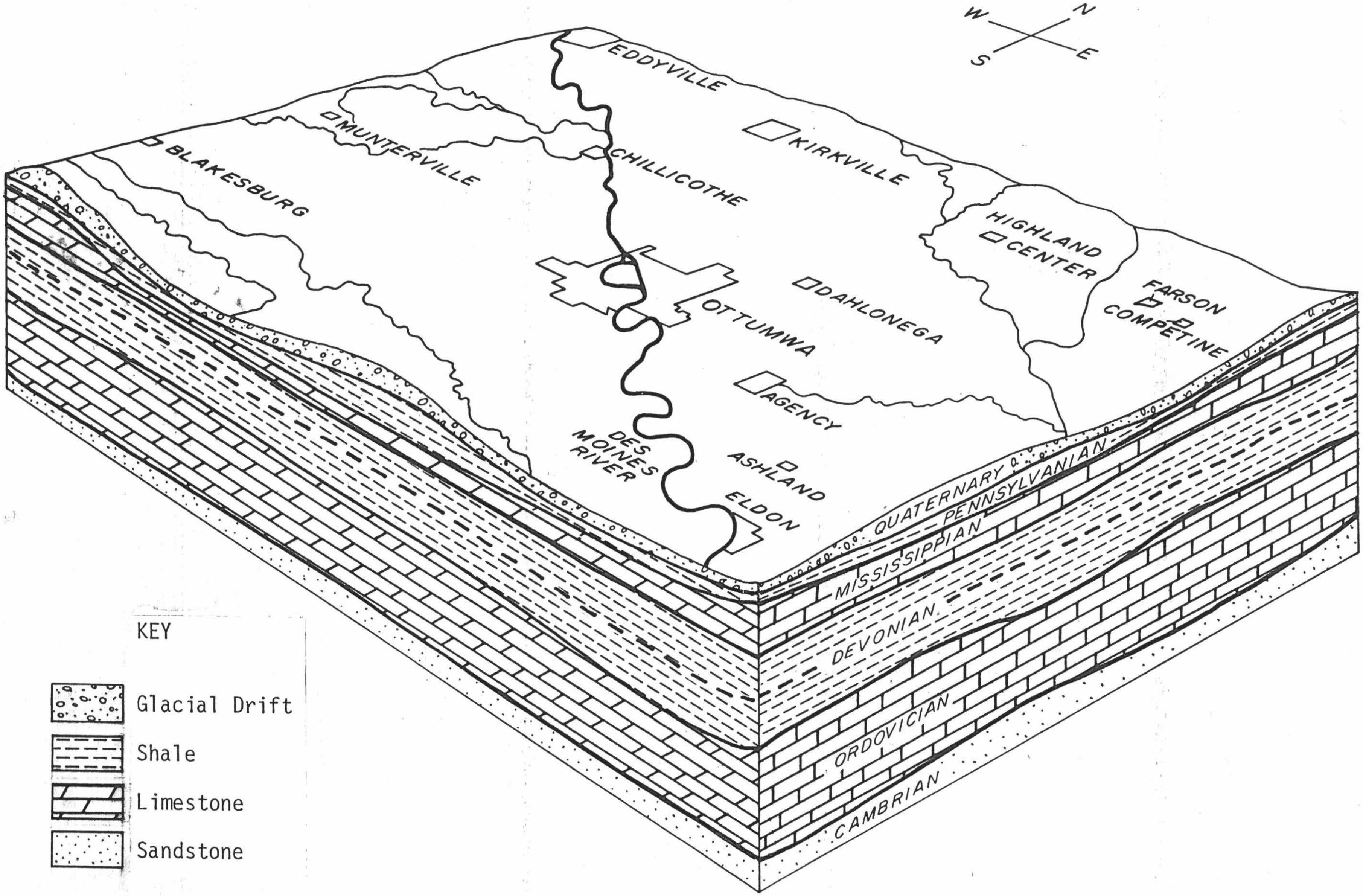


Figure 1

BLOCK DIAGRAM SHOWING THE GEOLOGY OF WAPELLO COUNTY

Examples of the sequence of rock units encountered in drilling existing wells at various locations in Wapello 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 Wapello 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

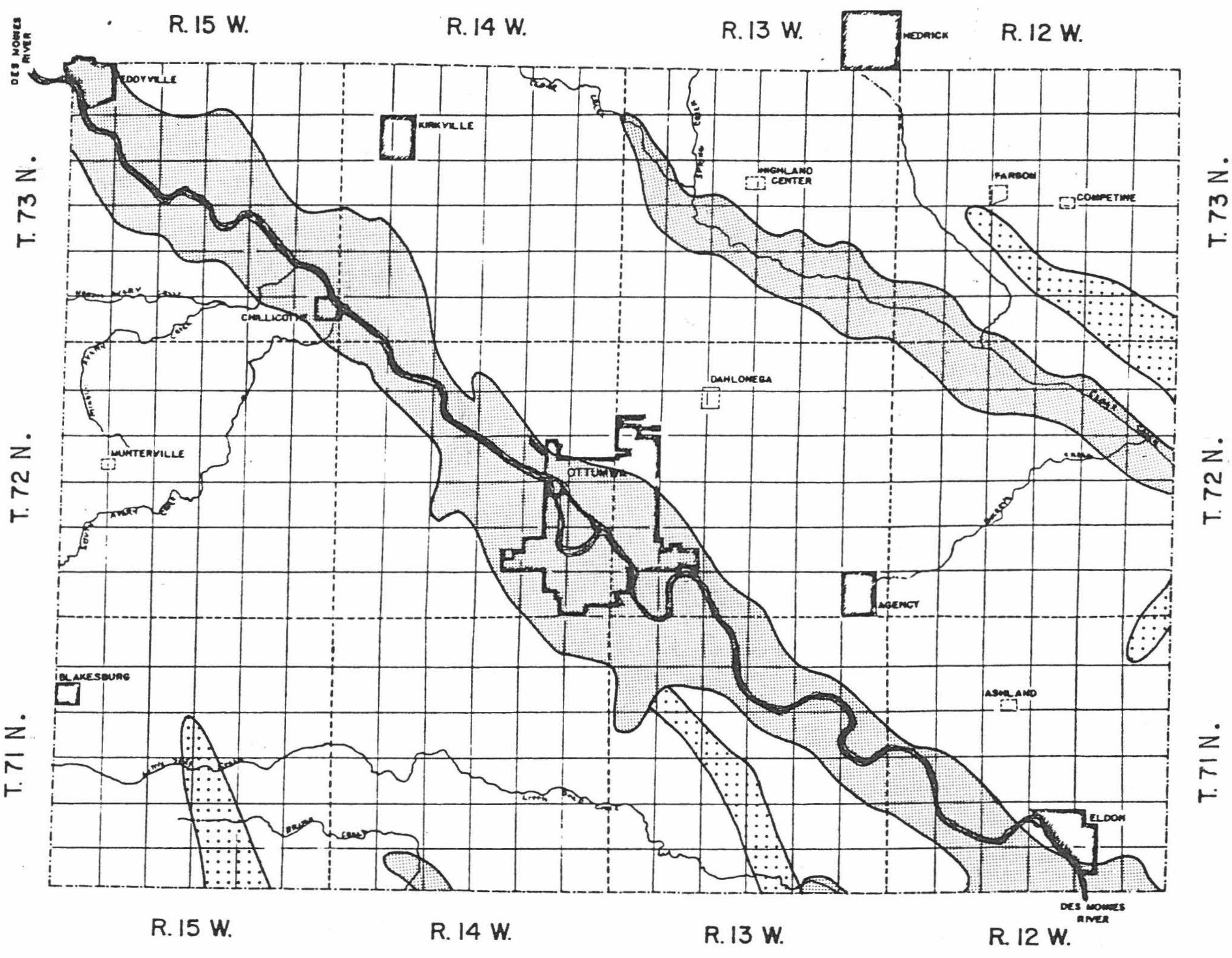
GEOLOGIC AND HYDROGEOLOGIC UNITS IN WAPELLO COUNTY

Age	Rock Unit	Description	Thickness Range*	Hydrogeologic Unit	Water-Bearing Characteristics
	Alluvium	Sand, gravel, silt and clay			Fair to large yields (25 to 100 gpm)
Quaternary	Glacial drift (undifferentiated)	Predominantly till containing scattered irregular bodies of sand and gravel	0-250 (feet)	Surficial aquifer	Low yields (less than 10 gpm)
	Buried channel deposits	Sand, gravel, silt and clay			Small to large yields
Pennsylvanian	Des Moines Series	Shale; sandstones; mostly thin	0-150	Aquiclude	Low yields only from limestone and sandstone
	Meramec Series	Sandy limestone			
Mississippian	Osage Series	Limestone and dolostone cherty; shale	150-450	Mississippian aquifer	Fair to low yields
	Kinderhook Series	Limestone, oolitic, and dolostone, cherty			
	Maple Mill Shale Sheffield Formation Lime Creek Formation	Shale; limestone in lower part	450-650	Devonian aquiclude	Does not yield water
Devonian	Cedar Valley Limestone Wapsipinicon Formation	Limestone and dolostone; contains evaporites (gypsum) in southern half of Iowa	650-1000	Devonian aquifer	Fair to low yields
	Maquoketa Formation	Shale and dolostone		Maquoketa Aquiclude	Does not yield water
	Galena Formation	Dolostone and chert		Minor aquifer	Low yields
Ordovician	Decorah Formation-Platteville Formation	Limestone, dolostone and thin shale includes sandstone in SE Iowa	1000-1800	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)
	Jordan Sandstone	Sandstone			
Cambrian	St. Lawrence Formation	Dolostone	1800	Aquitard	Low yields
	Franconia Sandstone	Sandstone and Shale			
	Dresbach Group	Sandstone		Dresbach aquifer	High to low yields
Precambrian	Undifferentiated	Coarse sandstones: crystalline rocks		Base of ground-water reservoir	Not known to yield water

* includes approximate depth to formation

Figure 2

SURFICIAL MATERIALS



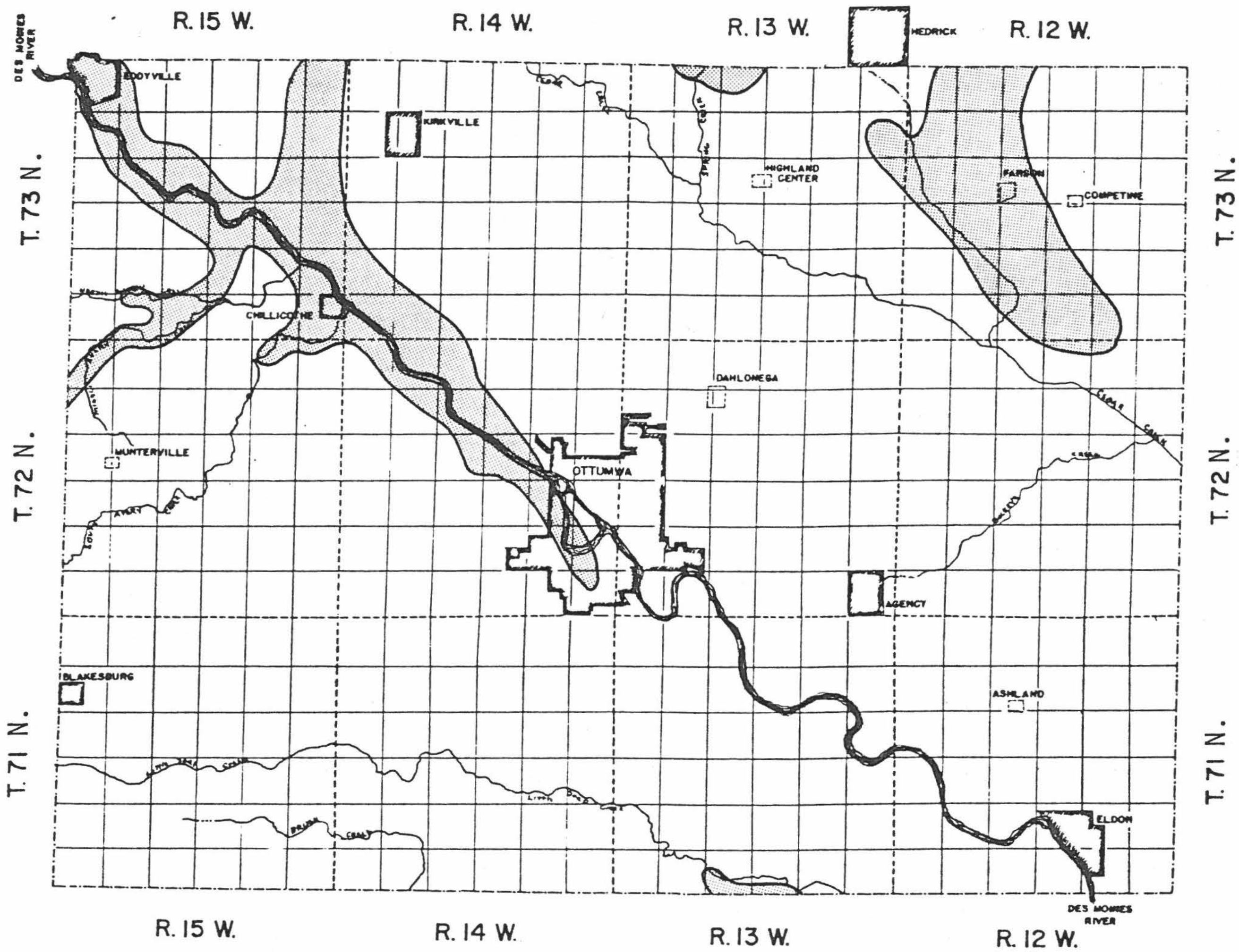
Alluvium

Glacial Drift

Buried Channels

Figure 3

GEOLOGIC MAP



Pennsylvanian

Mississippian - Upper Part

Figure 4

ELEVATION OF LAND SURFACE IN FEET ABOVE MEAN SEA LEVEL

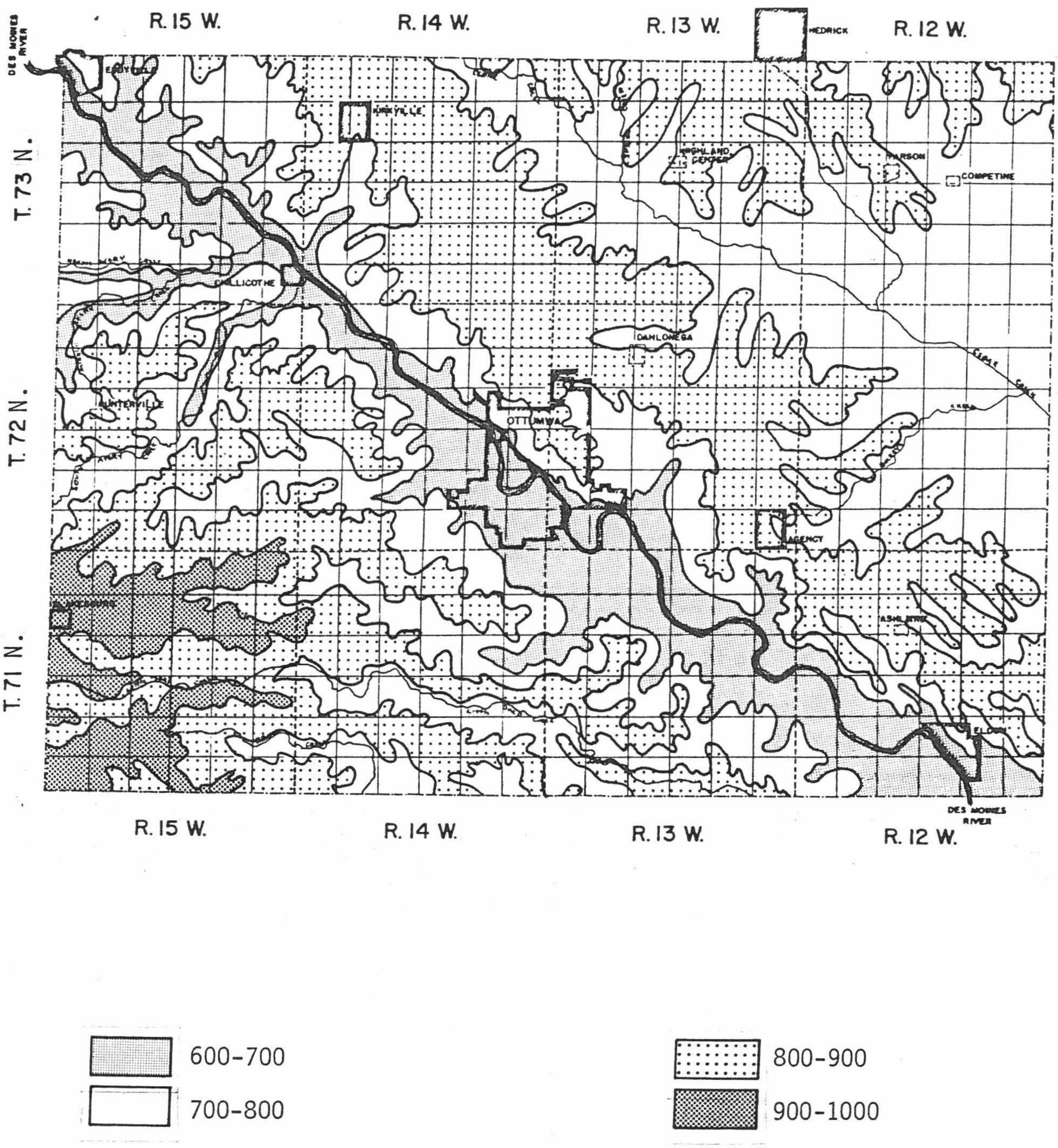


Figure 5

ELEVATION OF BEDROCK SURFACE IN FEET ABOVE MEAN SEA LEVEL

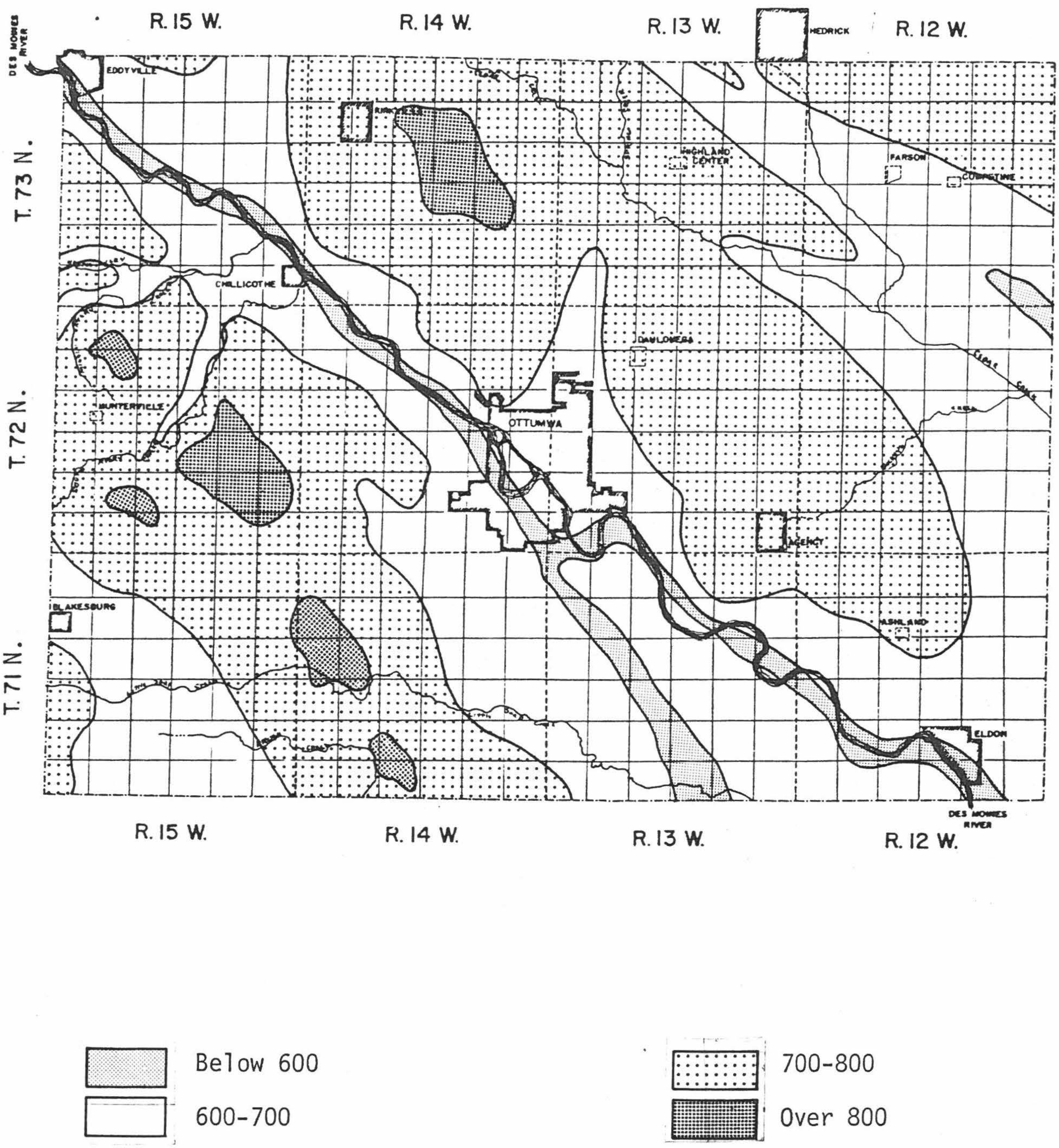


Figure 6

RANGE IN DEPTH TO WAPELLO COUNTY'S PRINCIPAL ROCK AQUIFERS

	R. 15 W.	R. 14 W.	R. 13 W.	R. 12 W.
T. 73 N.	BEDROCK 0-100 MISSISSIPPIAN 100-300 DEVONIAN 600-900 CAMBRO-ORDOVICIAN 1800-2000	BEDROCK 0-100 MISSISSIPPIAN 100-200 DEVONIAN 700-900 CAMBRO-ORDOVICIAN 1800-2000	BEDROCK 0-100 MISSISSIPPIAN 100-300 DEVONIAN 700-900 CAMBRO-ORDOVICIAN 1700-1900	BEDROCK 0-100 MISSISSIPPIAN 50-200 DEVONIAN 700-900 CAMBRO-ORDOVICIAN 1700-1900
T. 72 N.	BEDROCK 0-200 MISSISSIPPIAN 100-300 DEVONIAN 600-900 CAMBRO-ORDOVICIAN 1800-2000	BEDROCK 0-100 MISSISSIPPIAN 100-300 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1700-2000	BEDROCK 0-100 MISSISSIPPIAN 100-300 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1700-2000	BEDROCK 0-100 MISSISSIPPIAN 100-200 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1700-1900
T. 71 N.	BEDROCK 50-300 MISSISSIPPIAN 100-300 DEVONIAN 700-1000 CAMBRO-ORDOVICIAN 1900-2100	BEDROCK 50-250 MISSISSIPPIAN 100-300 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1750-2000	BEDROCK 0-100 MISSISSIPPIAN 100-200 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1750-2000	BEDROCK 0-100 MISSISSIPPIAN 100-200 DEVONIAN 500-900 CAMBRO-ORDOVICIAN 1700-1900

Figure 7

INDEX MAP FOR TYPICAL WELLS IN WAPELLO COUNTY

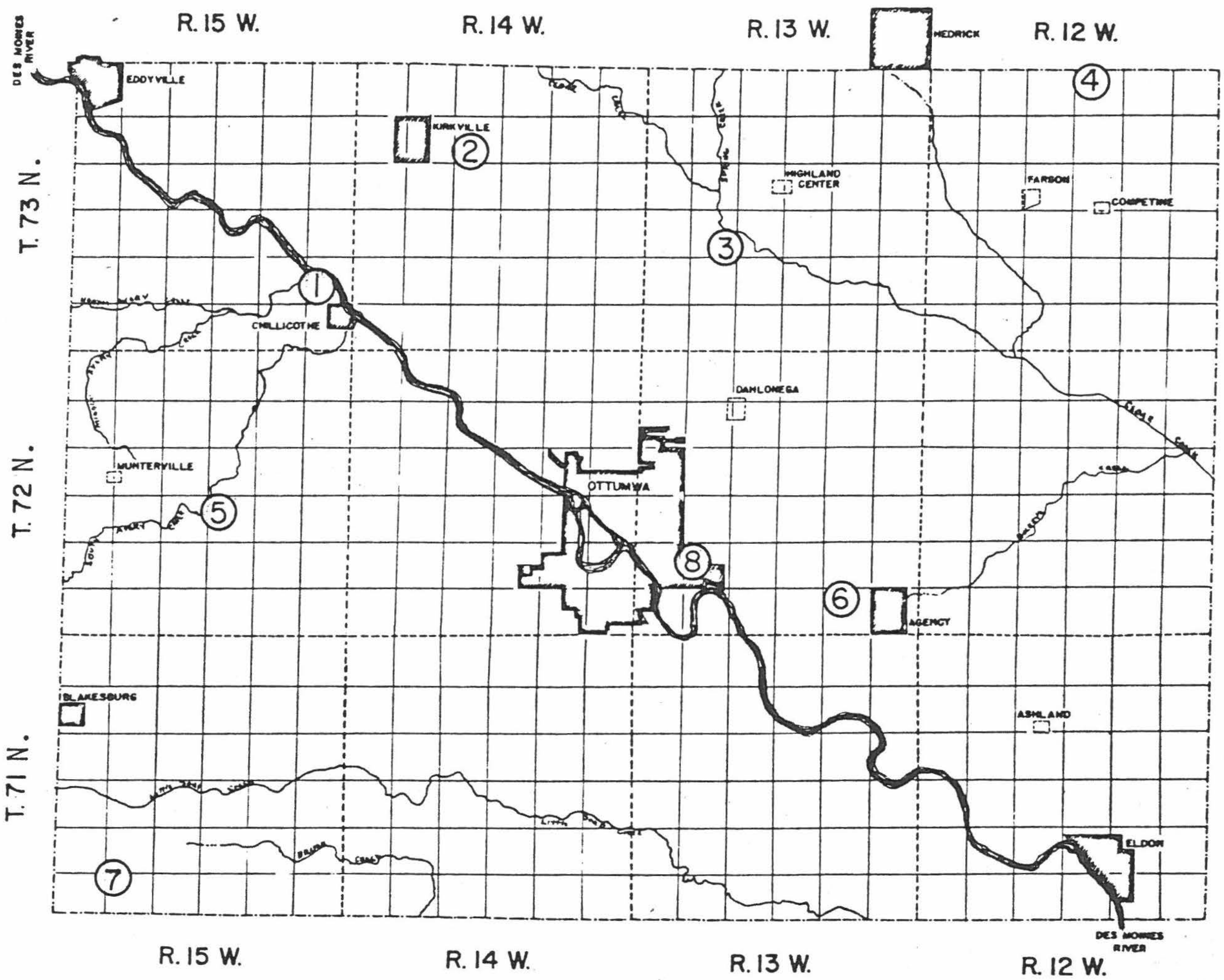


Figure 8

TYPICAL WELLS IN WAPELLO COUNTY

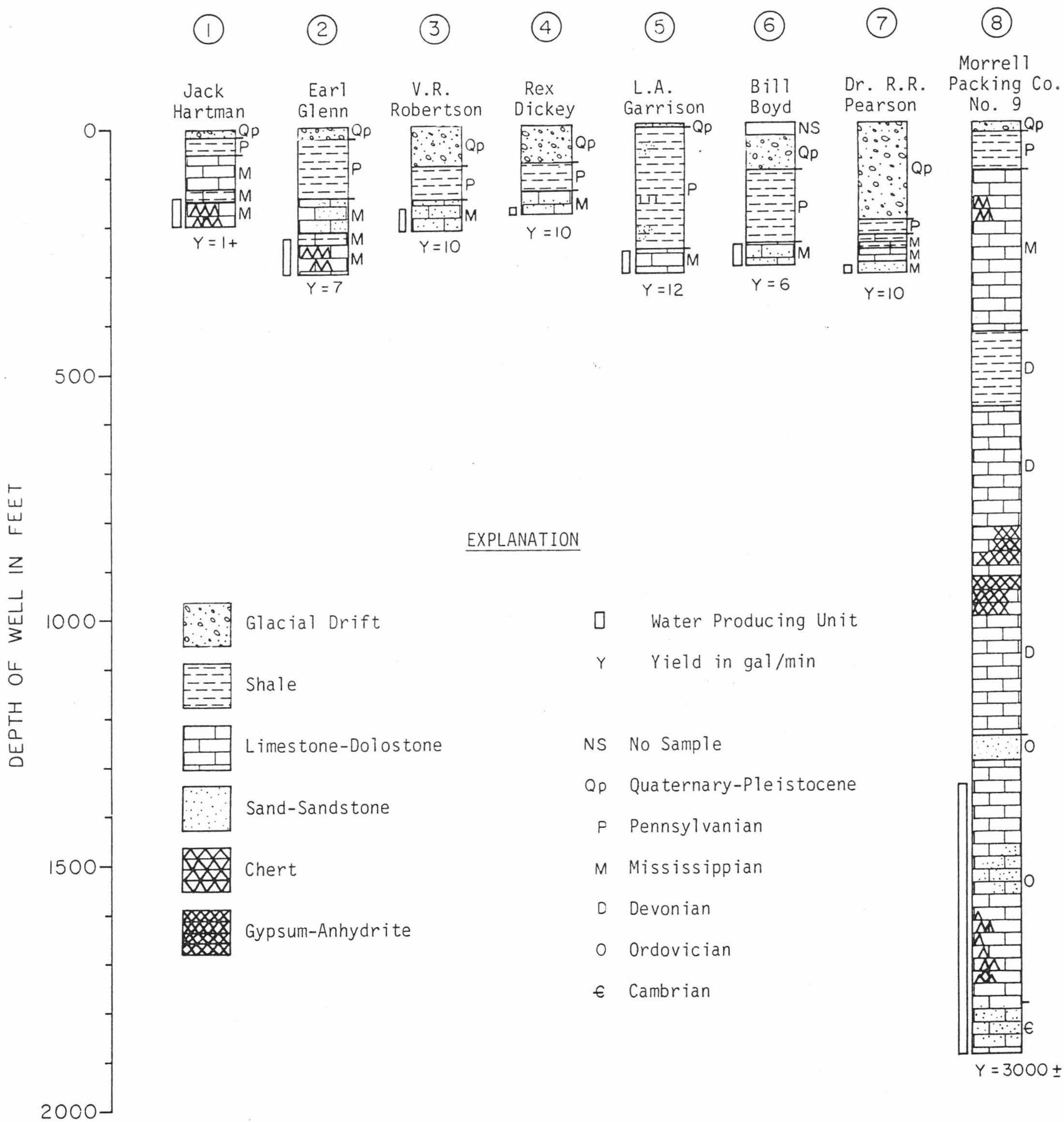
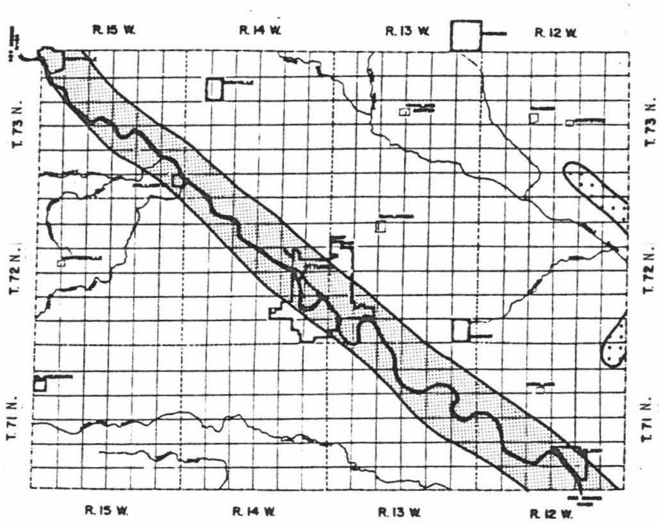


Figure 9
SURFICIAL AQUIFERS

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 fluctuate 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

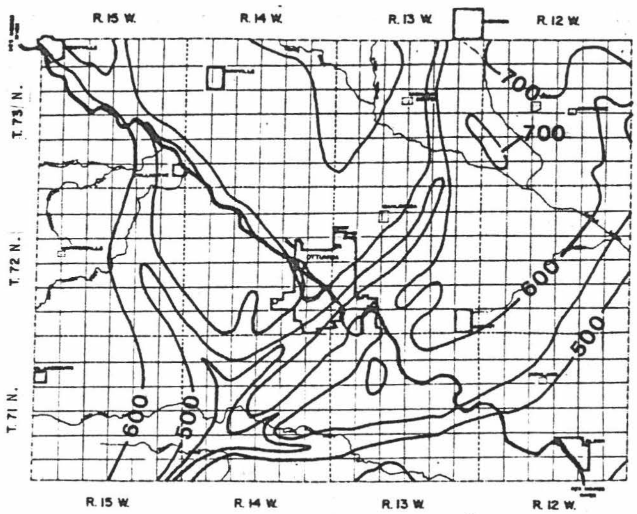
Below 20

20-100

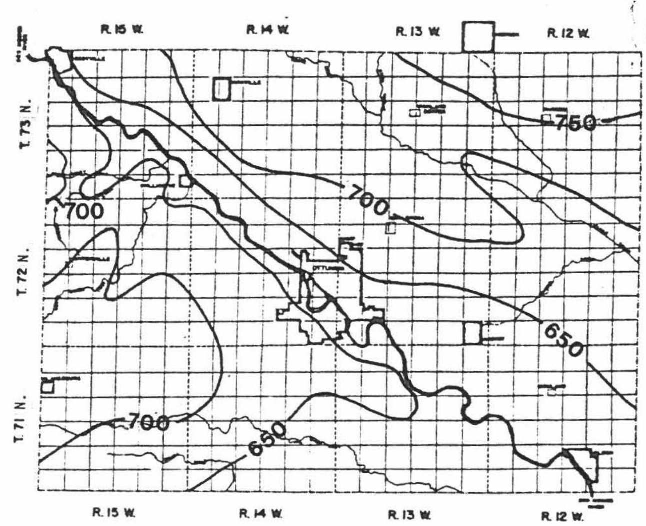
100-500

Figure 10

MISSISSIPPIAN AQUIFER

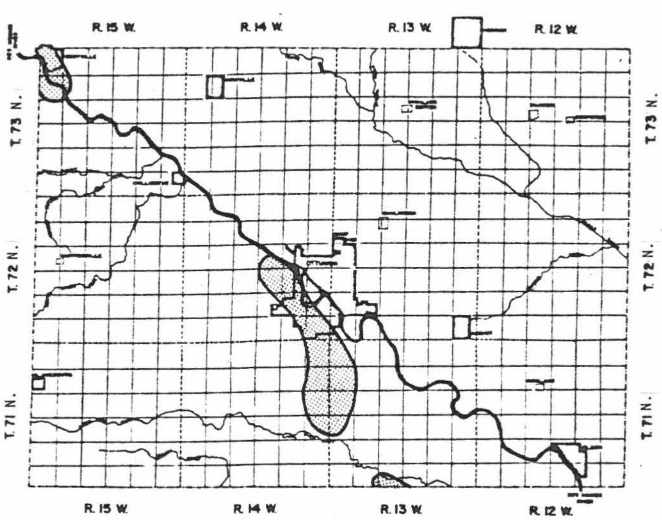


Elevation of Mississippian Aquifer in feet above mean sea level



Water levels in wells in feet above mean sea level

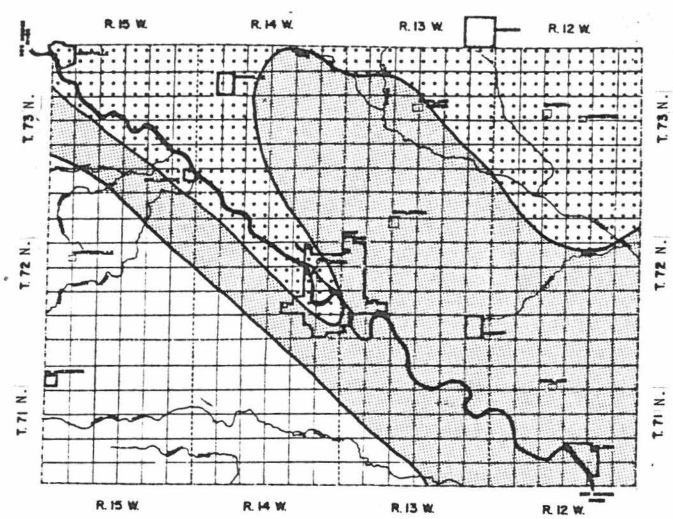
Upper-Part



Water yields to wells in gallons per minute

Below 20

20-50



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

500-1000

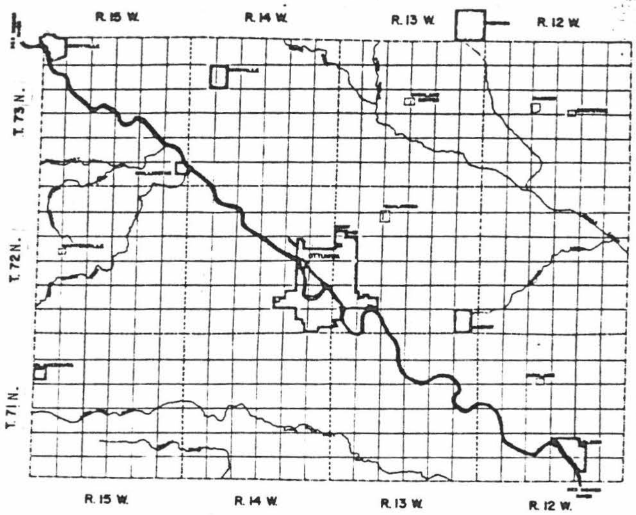
1000-2500

Greater than 2500

*Other water quality data in Figure 13

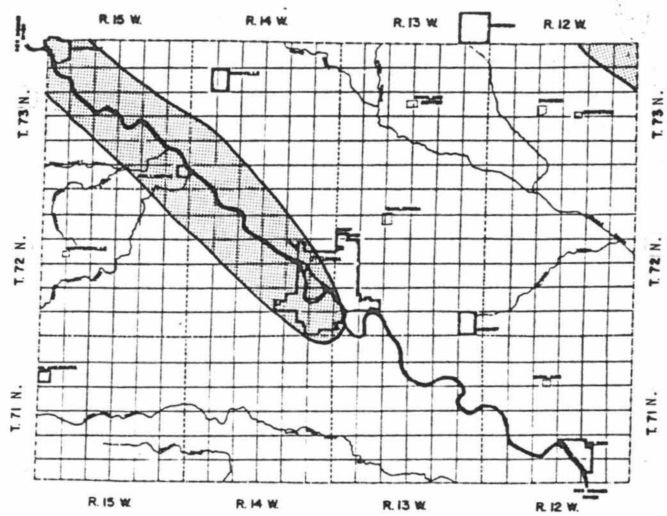
MISSISSIPPIAN AQUIFER

Lower Part



Water yields to wells in gallons per minute

Below 20



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

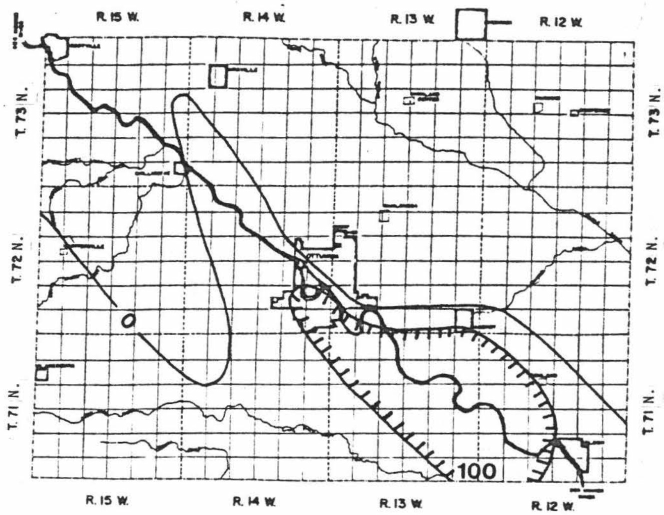
1000-2500

2500-5000

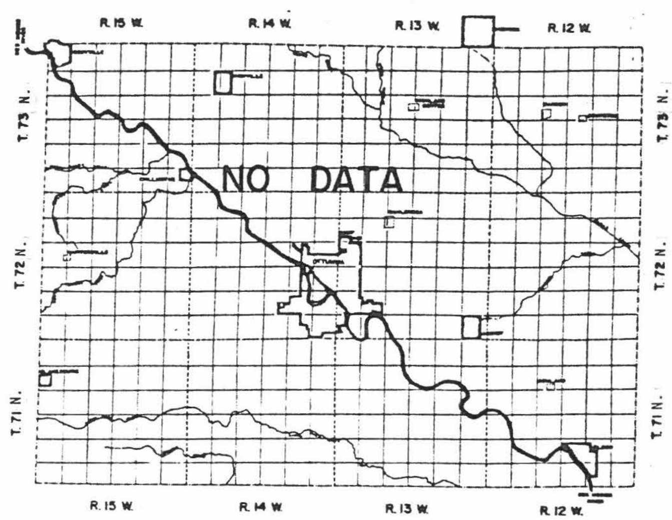
*Other water quality data in Figure 14

Figure 11

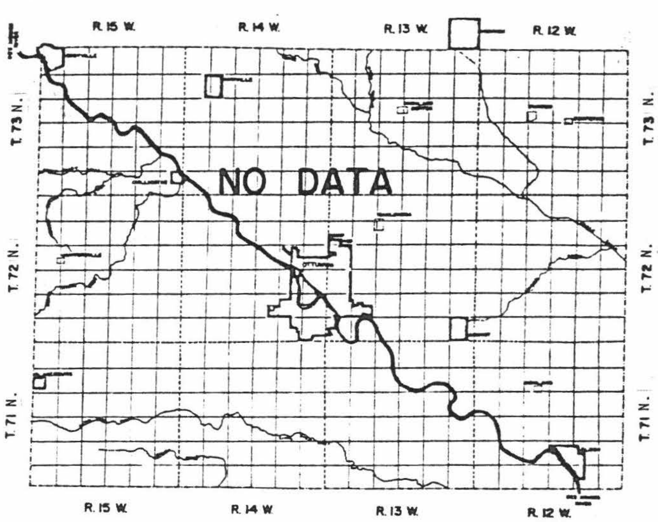
DEVONIAN AQUIFER



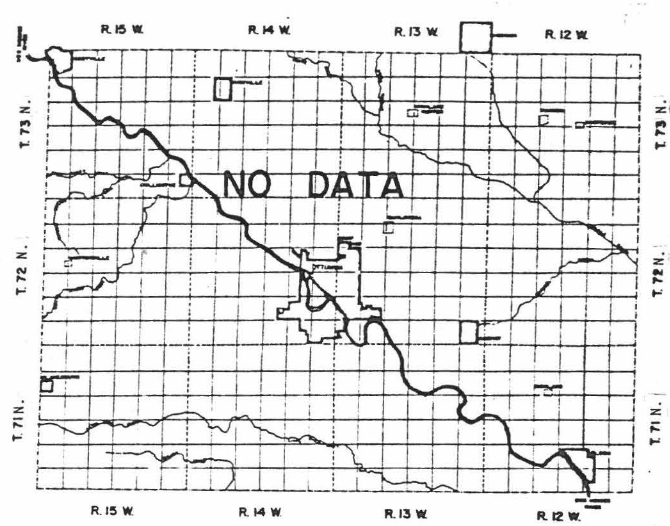
Elevation of Devonian Aquifer in feet above mean sea level



Water levels in wells in feet above mean sea level



Water yields to wells in gallons per minute

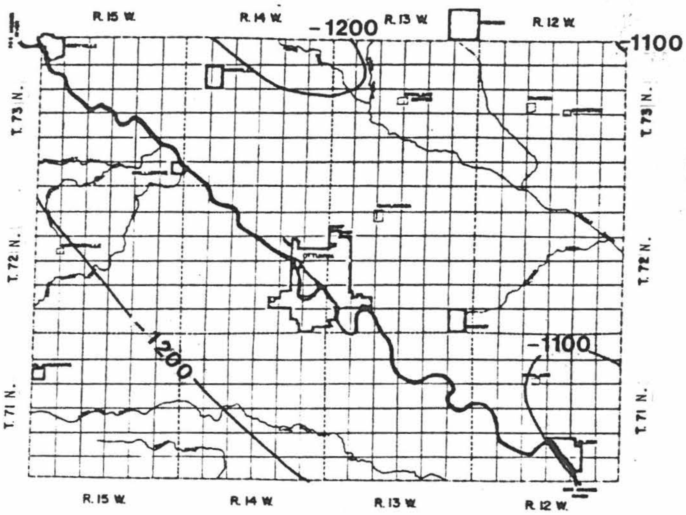


Dissolved solids content in milligrams per liter (mg/l)*

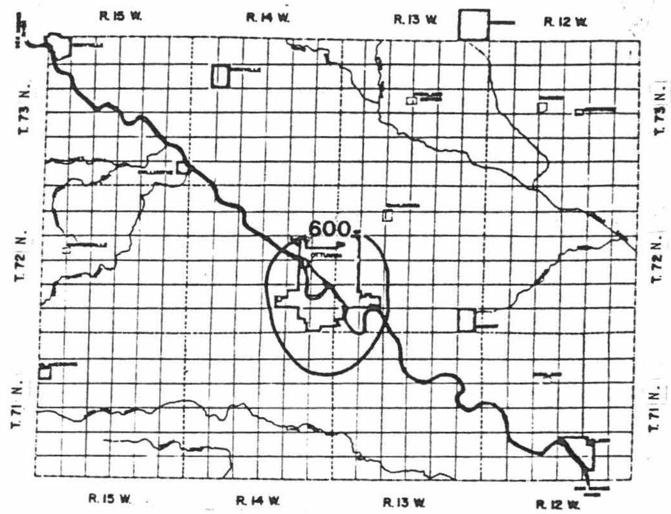
*Other water quality data in Figure 15

Figure 12

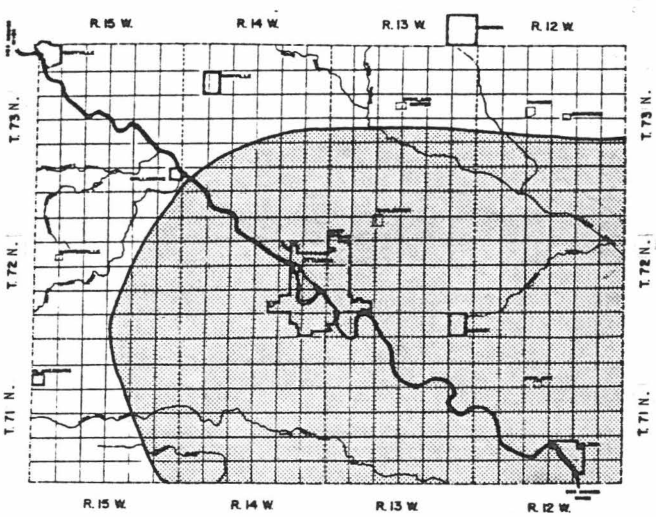
CAMBRO-ORDOVICIAN (JORDAN) AQUIFER



Elevation of Jordan aquifer in feet above sea level



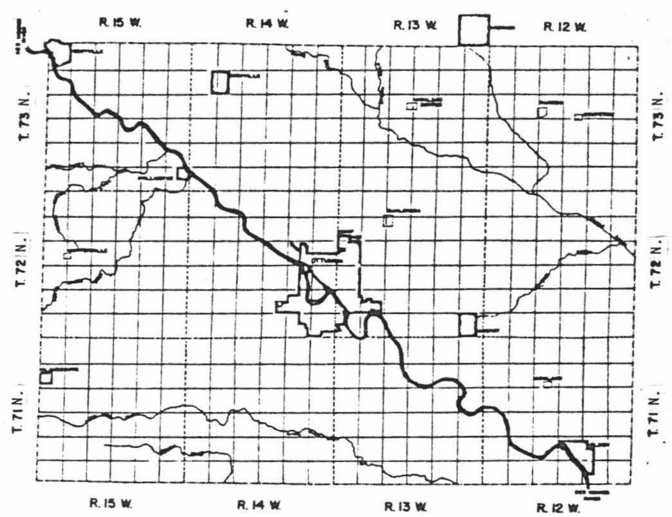
Water levels in wells in feet above mean sea level



Water yields to wells in gallons per minute

500-1000

more than 1000



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

1000-1500

*Other water quality data in Figure 15

Table 2

SIGNIFICANCE OF MINERAL CONSTITUENTS AND PHYSICAL PROPERTIES OF WATER

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.

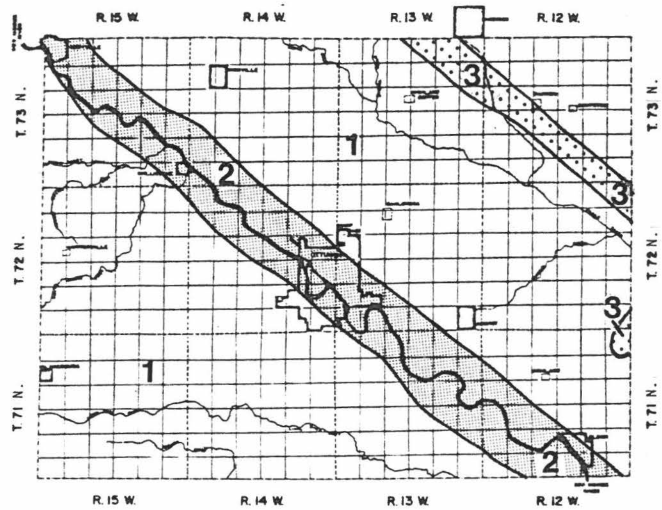
Recommended standards for common water constituents are described in the table above. These are rationally accepted as guidelines for acceptable drinking water supplies. Limits for uses other than drinking often differ from these. For instance, water that is unacceptable for drinking and household use may 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 mineral constituents are summarized in Figures 13, 14 and 15 for the 4 major aquifers in Wapello County. Recommended concentrations for some constituents are often exceeded without 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

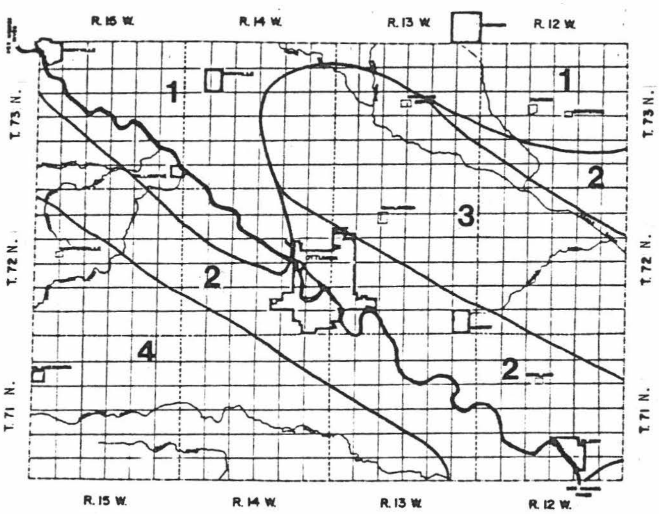
Surficial Aquifers



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	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					
3	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

The alluvial and drift aquifers yield good quality water. The dissolved solids content is high, but is acceptable for drinking purposes if no other water is available. Water from buried channel aquifers has a lower dissolved solids concentration. Water temperatures average 54°F (12.0°C) and the range of temperatures is from 48°F to 58°F (9.0°C to 14.5°C).

Mississippian Aquifer
Upper Part



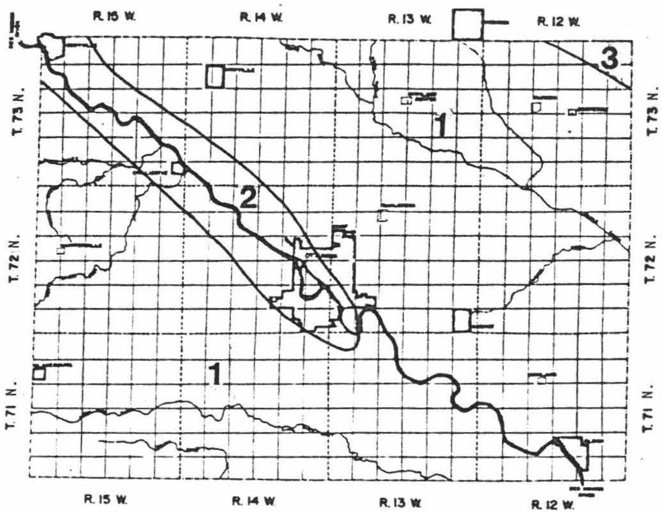
Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
1	A	104	32	43	472	91	4.5	0.4	537	399
	R	66-156	19-50	8.8-118	322-802	5.8-240	0.5-24	0-1.8	345-737	315-545
2	A	299	92	125	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
3	A	61	31	404	608	587	22	2.1	1400	281
	R	54-69	25-37	275-513	471-736	400-710	20-25	.9-3.5	1060-1490	240-324
4	A	327	76	679	284	2160	68	1.4	3620	1130
	R	154-490	54-99	474-1080	212-350	1500-2850	27-186	1.2-2.4	2710-4880	605-1520

Fair water quality is available in the upper part of the Mississippian aquifer, which is more highly mineralized than that typically found in the surficial aquifers and is usually very hard. Except for along the northern border, the dissolved solids content is high, particularly in the south western portion of the county. For most of the county, sulfate concentrations exceed recommended standards. Average water temperature is 55°F (13°C) and the range of temperatures is from 51°F to 60°F (10.5°C to 15.5°C).

Figure 14

Mississippian Aquifer

Lower Part



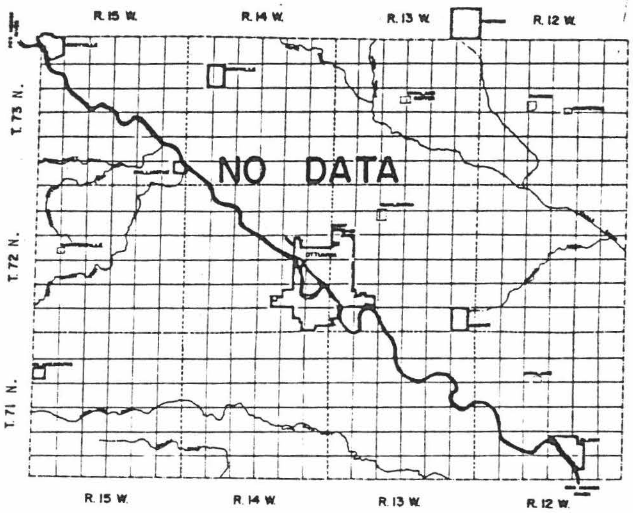
Area	Average and Range	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Dissolved Solids	Hardness (as $CaCO_3$)
1	A	102	52	718	459	1340	169	2.6	2710	469
	R	35-193	15-107	451-994	266-595	920-1660	19-365	.5-6	2220-3250	148-891
2	A	354	36	38	371	295	86		1500	1040
	R	299-410	24-48	28-47	322-420	8-582	9-162		1190-1800	849-1230
3	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

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 and with the exception of the extreme northeast corner and along the Des Moines River from Eddyville to Ottumwa, greatly exceeds recommended values for sulfate content. Total dissolved solids are extremely high and flouride content is generally a bit high. Average water temperature is 55°F (13°C), and the range of temperature from 51°F to 60°F (10.5°C to 15.5°C).

Figure 15

CHEMICAL CHARACTER OF GROUND WATER

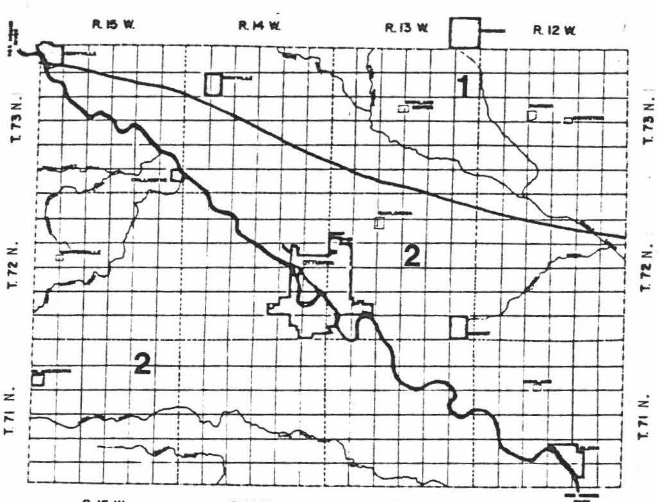
Devonian Aquifer



NO DATA

For the Devonian aquifer in this county, which is not a potable water source, there is no immediate data available, but from data extrapolation of nearby counties, the water quality is found to be very poor. The water is highly mineralized with sulfate, sodium, iron and manganese and has a very high content of dissolved solids, most likely in excess of 10,000 mg/l. Water temperatures are higher than that from the Mississippian aquifers sources averaging 60°F (15.5°C) and with a temperature range of 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	106	50	202	304	552	52	1.2	1180	470
	R	98-116	46-54	192-211	283-337	520-600	38-60	1.0-1.5	1120-1240	452-510
2	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

This deep aquifer yields water of relatively good quality compared to the other rock aquifers. However, the water is noticeably hard and exceeds recommended standards for sulfates and dissolved solids. Water temperatures are higher than other rock aquifer sources averaging 72°F (22°C) and with a temperature range 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 procedures 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 downslope 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.

Locate a well where it will be accessible for maintenance, inspection, and repairs. If a pump house is located some distance from major buildings and wired separately for power, continued use of the water supply will be jeapordized by fire in major buildings.

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, Un. of Iowa, Oakdale Campus, Iowa City, Iowa 52242. Indicate whether your water has been treated with chlorine, iodine, or bromine; for 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 anytime 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 Wapello 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 the natural conditions that existed before well construction and prevent any future 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 groundwater supply or contracting for the drilling of a new well, additional information is often required. This section lists several types and sources of information.

State Agencies

Iowa Department of Natural Resources (515)-281-8666
Environmental Protection Division
Wallace Building
Des Moines, IA 50319-0034

(Pollution problems, public drinking water, wastewater treatment, water quality, assistance to local communities, protection of surface and underground reservoirs, allocates water use, permits water use of 25,000 or more gallons per day)

Environmental Protection Division (319) 653-2135
Regional Office No. 6
117 N. 2nd Avenue
Washington, IA 52343

(Municipal water supplies and waste water treatment routine sanitary inspections, local pollution problems, assistance to communities)

Energy and Geological Resources Division (319) 335-1575
Geological Survey Bureau
123 North Capitol Street
Iowa City, IA 52242

(Geologic and groundwater data repository, consultant for well problems, well forecasing, hydrogeologic research, and related services)

Iowa Department of Public Health (515) 281-4942
Lucas Building
Des Moines, IA 50319

(Promotes public health hygiene and sanitation; programs of health education, quality of health care)

University of Iowa Hygienic Laboratory (319) 335-4500
University of Iowa
Oakdale Campus
Iowa City, IA 52242

(Water analyses)

Cooperative Extension Service (515) 294-4569
Iowa State University
Ames, IA 50011

(Advice on water system design and maintenance)

Well Drillers and Contractors

The listing provided here was drawn from an Iowa Geological Survey mailing list and yellow pages of major towns in phone books. These selected are within an approximate radius of 50 miles of Wapello County. For a state-wide listing contact either the Iowa Water Well Drillers Association, 4350 Hopewell Ave., Bettendorf, Iowa 51712, (319) 355-7528 or the Iowa Geological Survey.

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

Bruinekool Well Co.
Oskaloosa, IA 52577

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

Kramer Well Co.
Mt. Pleasant, IA 52641

Lyon Well Co.
Salem, IA 52649

Schlicher Bros. Well
Hwy 34 West
Fairfield, IA 52556

Brooks Well and Pump Co.
R.R. 2
Knoxville, IA

Bruinekool Well Co.
Pella, IA 50219

Verwers Well Co.
Sully, IA 50251

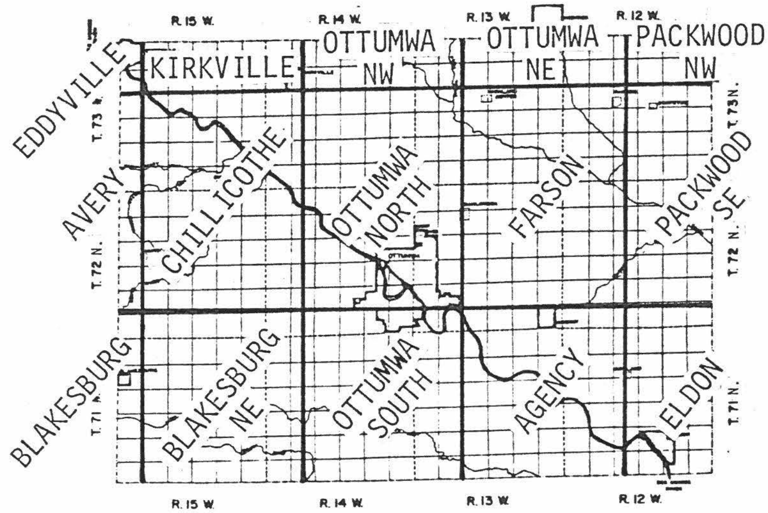
Snook Well Co.
R.R. 1
Promise City, IA 52583

Campbell Well
701 South Columbia
Bloomfield, IA

Doyle Van de Krol
Sully, IA 50251

Neal Lyon Well Co.
Salem, IA 52649

Topographic Maps (Available from the Iowa Geological Survey)



Map Title	Date (Published)	Scale	Contour Interval
Eddyville	1968-(76-1)*	1:24,000	10'
Avery	1968-(76-1)	1:24,000	10'
Blakesburg	1968-(76-1)	1:24,000	10'
Kirkville	1968-(76-1)	1:24,000	10'
Chillicothe	1968-(76-1)	1:24,000	10'
Blakesburg NE	1968-(76-1)	1:24,000	10'
Ottumwa North	1956	1:24,000	10'
Ottumwa South	1956	1:24,000	10'
Farson	1956	1:24,000	10'
Agency	1956	1:24,000	10'
Eldon	1965 (Preliminary)	1:24,000	10'
Ottumwa NW		1:24,000	10'
Ottumwa NE		1:24,000	10'
Packwood NW		1:24,000	10'
Packwood SE		1:24,000	10'

*Map photoinspected 1976 – no major culture or drainage changes observed

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.