GROUNDWATER RESOURCES

Madison County

GWR-61
1988
Compiled by JEAN C. PRIOR

Iowa Department of Natural Resources
Geological Survey Bureau

GROUND-WATER RESOURCES OF MADISON COUNTY

Introduction

Approximately 70% of the water used by residents of Madison County comes from ground-water sources. It is extimated that the use of ground water in the county currently approaches .66 billion gallons per year. For comparison, this amount would provide each resident with 156 gallons of water a day during the year. These high per capita figures reflect the greater demands of livestock and comercial uses.

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 Madison County where the availability of ground water is not limited. 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 of adequate sources.

Occurrence of Ground Water in Madison County

The occurrence of ground water is influenced by geological conditions--position and thickness of rock units, their ability to store and transmit water, and their physical and chemical make-up. Geologic units that store, transmit, and yield appreciable amounts of water 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 composed of 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 Madison County there are two principal sources from which users obtain water supplies: the loose, unconsolidated materials near the land surface that comprise the surficial aquifer, and a deep rock aquifer. Between the surficial aquifer and the deep (Cambro-Ordovician) aquifer are two other major water-bearing units, the Mississippian and the Devonian-Silurian aquifer systems. However, throughout Madison County the water contained in these aquifers is highly mineralized and too poor in quality for human or livestock use. Figure 1 shows the geologic relationships of these units beneath the county. Each aquifer 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 bounders. The water-yielding potential of these deposits is greater in units composed mostly of sand and/or gravel. Three types of surficial aquifers are used in the county: alluvial aquifers, the drift aquifer, and buried-channel aquifers.

Alluvial aquifers consist mainly of sand and gravel transported and deposited by modern streams, and they occur beneath the floodplains and terraces in major valleys. Alluvial deposits are shallow, generally less than 50-60 feet in depth, and because of their near-surface position may easily be contaminated by the infiltration of surface water.

The drift aquifer is the thick layer of clay to bounder-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 most places does not yield much water. There may be, however, lenses or beds of sand and gravel within the drift that are thick and widespread enough to store and furnish dependable water. These may be difficult to locate because of their irregular shape and because they are buried within other drift materials. Usually one or two sand layers can be found in most places that will yield enough water to meet domestic needs.

Buried channel aquifers consist of alluvial sand and gravel deposited in pre-glacial stream valleys. The valleys were overridden by glaciers and are now buried under the drift. These buried valleys may or may not coincide with the courses of modern rivers and their alluvial sediments.

The distribution, yields, and water-quality characteristics of the surficial aquifers are summarized in Figures 2 and 9 and Table 3. An indication of general thicknesses can be obtained by comparing the elevation of the land surface with the top of the bedrock surface in Figures 4 and 5. The thickness of the glacial drift or the depth of buried channels at any location can be determined by subtracting the elevation of the bedrock surface from the elevation of the land surface.

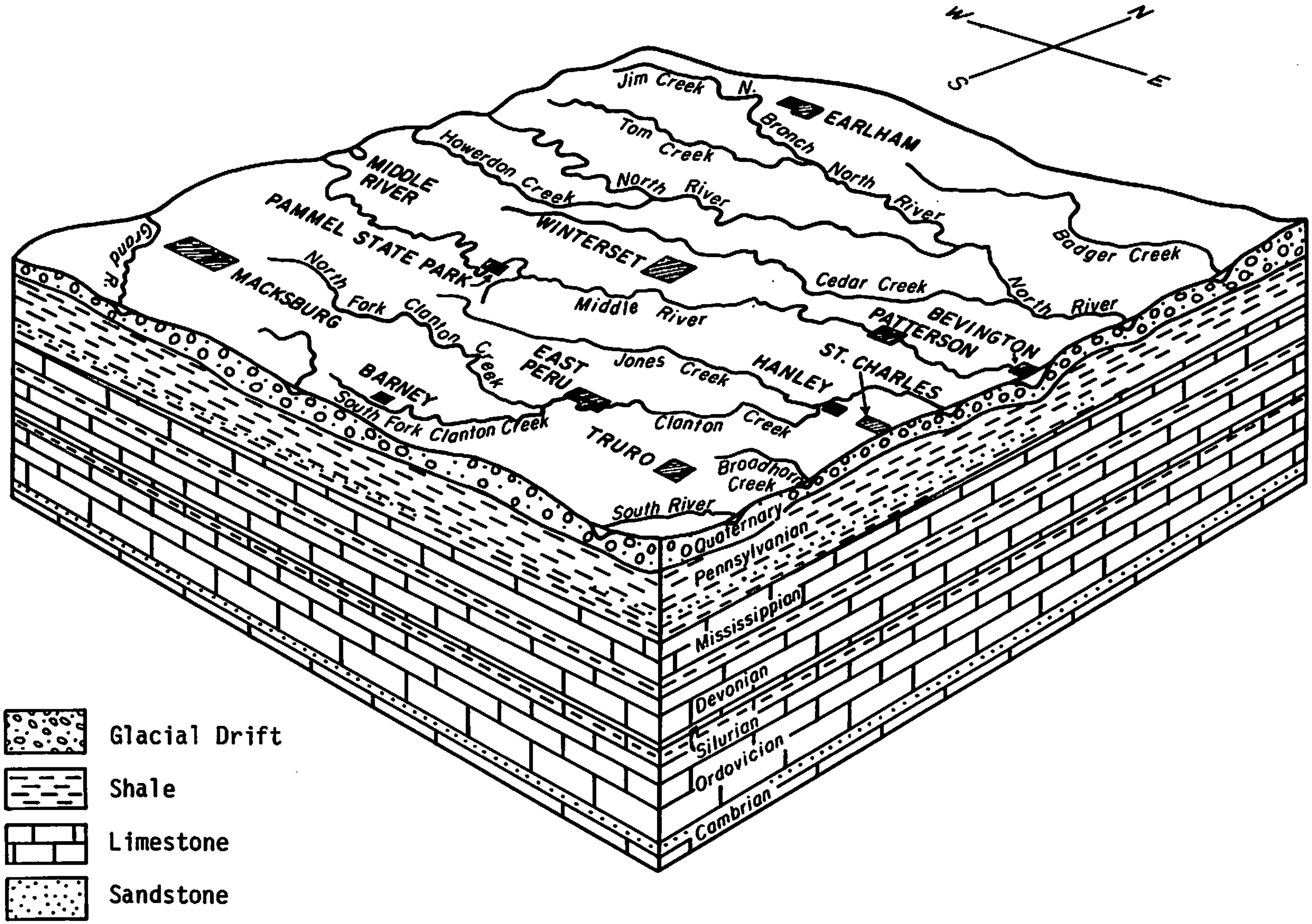


Figure 1

BLOCK DIAGRAM SHOWING THE GEOLOGY OF MADISON COUNTY

Rock Aquifers

Below the drift and other surficial materials is a thick sequence of layered rocks formed from deposits of rivers and shallow seas that alternately covered the state during the last 600 million years. The geologic map (Figure 3) shows the geologic units which form the surface of this rock sequence. These rocks are Pennsylvanian in age and are mainly shales. Although the Pennsylvanian rocks usually act as an aquiclude, sandstone units within the Cherokee Group and limestone units within the Kansas City Group provide several wells in the county with fair yields (5 to 20 gpm). The thickness of these units is quite variable, and the depth of wells drilled into them vary between 200 and 600 feet. The water drawn from wells in the Cherokee Group is of uniformly poor quality, with total dissolved-solids concentrations ranging from 1000 to 6000 mg/l and sulfate concentrations that generally exceed 1000 mg/l.

Underlying the Pennsylvanian aquiclude is a sequence of older rocks, portions of which form the major rock aquifers beneath Madison County. This sequence and its water-bearing characteristics are shown in Table 1.

Examples of the rock units encountered in several wells at various locations in Madison County are indexed and illustrated in Figures 7 and 8. The geologic unit that supplies ground water and the rate of yield are shown for each well.

The accessibility of ground water in rock aquifers depends 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 11, 12, and 13. 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.

A second factor which affects ground-water accessibility is the level to which the water will rise in a well (The static water level). Throughout the county, water in the rock aquifers is under artesian pressure and rises in wells once the aquifer is penetrated. This can reduce the cost of pumping. Average static water levels for Madison County wells are shown in Figures 11, 12, and 13.

Average rates of yield and water-quality characteristics for each of the aquifers are summarized in the maps in Figures 11, 12, 13, and Table 4.

Table 1.

GEOLOGIC AND HYDROGEOLOGIC UNITS IN MADISON COUNTY

Geologic Age	Rock Unit	Description	Thickness Range	Hydrogeologic Unit	Water-Bearing Characteristics
Quaternary	Alluvium	Sand, gravel, silt and clay	0-250 (feet)	Surficial aquifer	Fair to large yields (25 to 100 gpm)
	Glacial Drift	Dominantly till with 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	Missouri Series	Alternating shale and limestone	400-800	Aquiclude	Low yields only, from limestone and sandstone
	Des Moines Series	Shale, sandstones, and thin limestones; thin coal			
Mississippian	Meramec Series	Sandy limestone	360-440	Mississippian Aquifer	Fair to low yields
	Osage Series	Limestone and dolostone, cherty; some shale			
	Kinderhook Series	Limestone, oolitic and dolostone, cherty; also siltstone			
Devonian	Maple Mill Shale Sheffield Fm. Lime Creek Fm.	Shale in upper part; limestone in lower part	140-160	Aquiclude	Does not yield water
	Cedar Valley Limestone	Dolostone; contains gypsum	470-520	Devonian aquifer	Fair to low yields
	Wapsipinicon Fm.				
Silurian	Undifferentiated	Dolostone, cherty	35-60	Silurian aquifer	Fair yields
Ordovician	Maquoketa Fm.	Shale and cherty dolostone	961-940	Aquiclude	Does not yield water
	Galena Fm.	Dolostone		Minor aquifer	Low yields
	Decorah-Platteville Fms.	Dolostone, limestone, and thin shale		Aquiclude	Does not yield water
	St. Peter Sandstone	Sandstone		Cambro-Ordovician Aquifer	Fair yields
	Prairie du Chien Fm.	Dolostone, sandy; sandstone in middle part			High yields (over 500 gpm)
Cambrian	Jordan Sandstone	Sandstone	15-40		
	St. Lawrence Fm.	Dolostone		Aquitard	Low yields
	Franconia Series	Sandstone and shale			
	Dresbach Group	Sandstone		Dresbach aquifer	
Precambrian	Undifferentiated	Coarse sandstone; crystalline rocks		Base of groundwater resevoir	Not known to yield water

Figure 2

SURFICIAL MATERIALS OF MADISON COUNTY

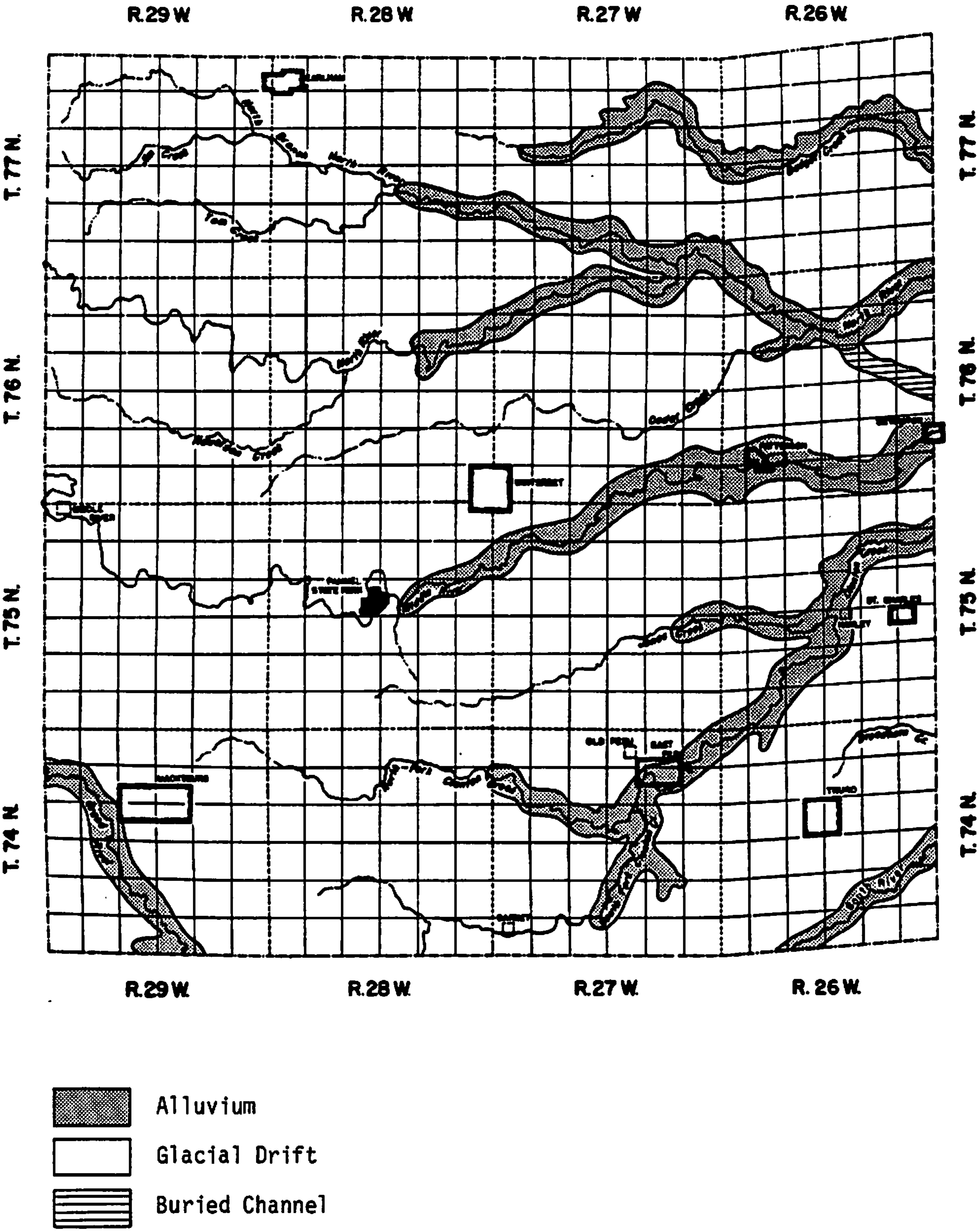
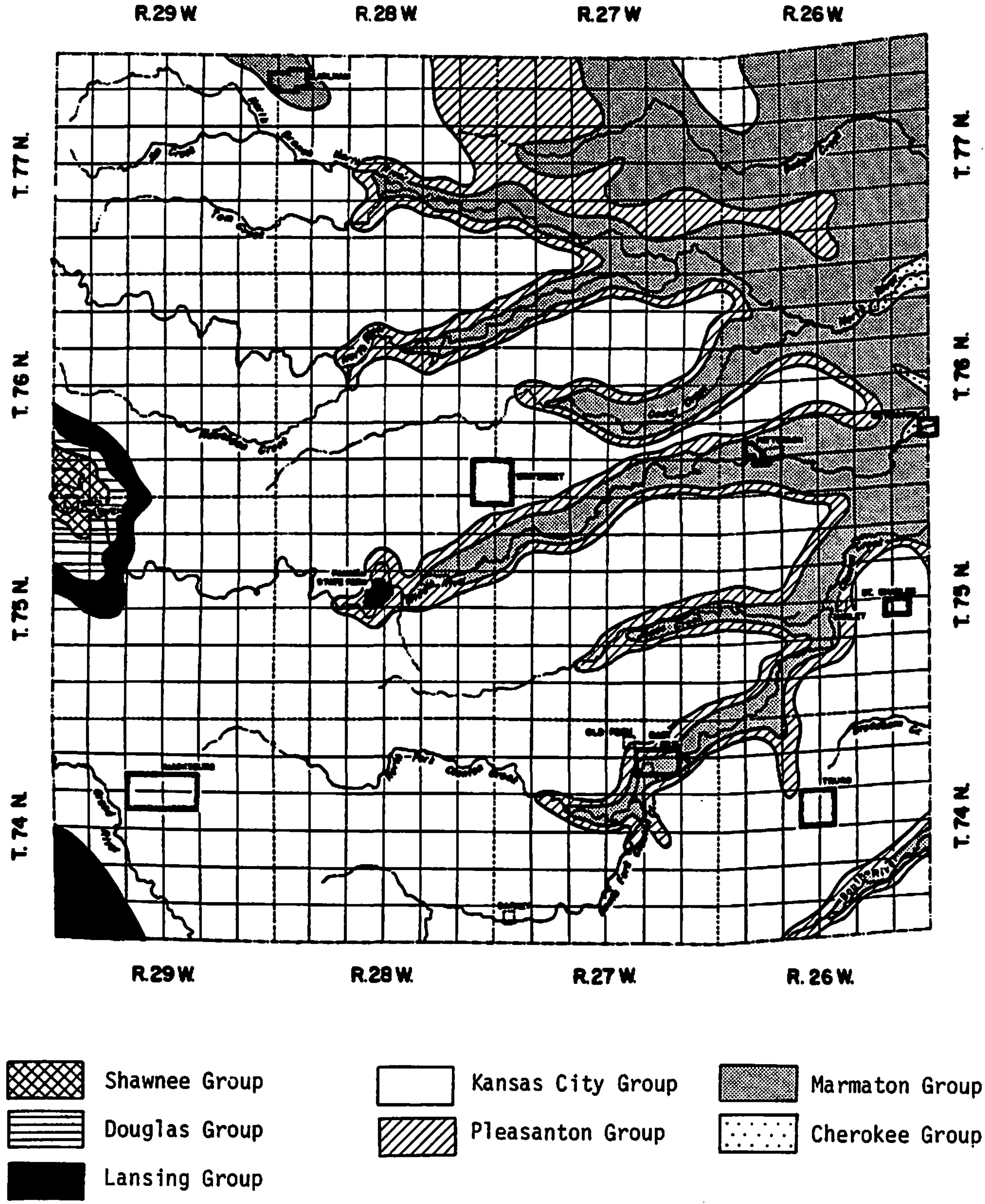


Figure 3

BEDROCK HYDROGEOLOGIC MAP OF MADISON COUNTY



PENNSYLVANIAN AQUICLUDE

Figure 4

ELEVATION OF LAND SURFACE OF MADISON COUNTY IN FEET ABOVE MEAN SEA LEVEL

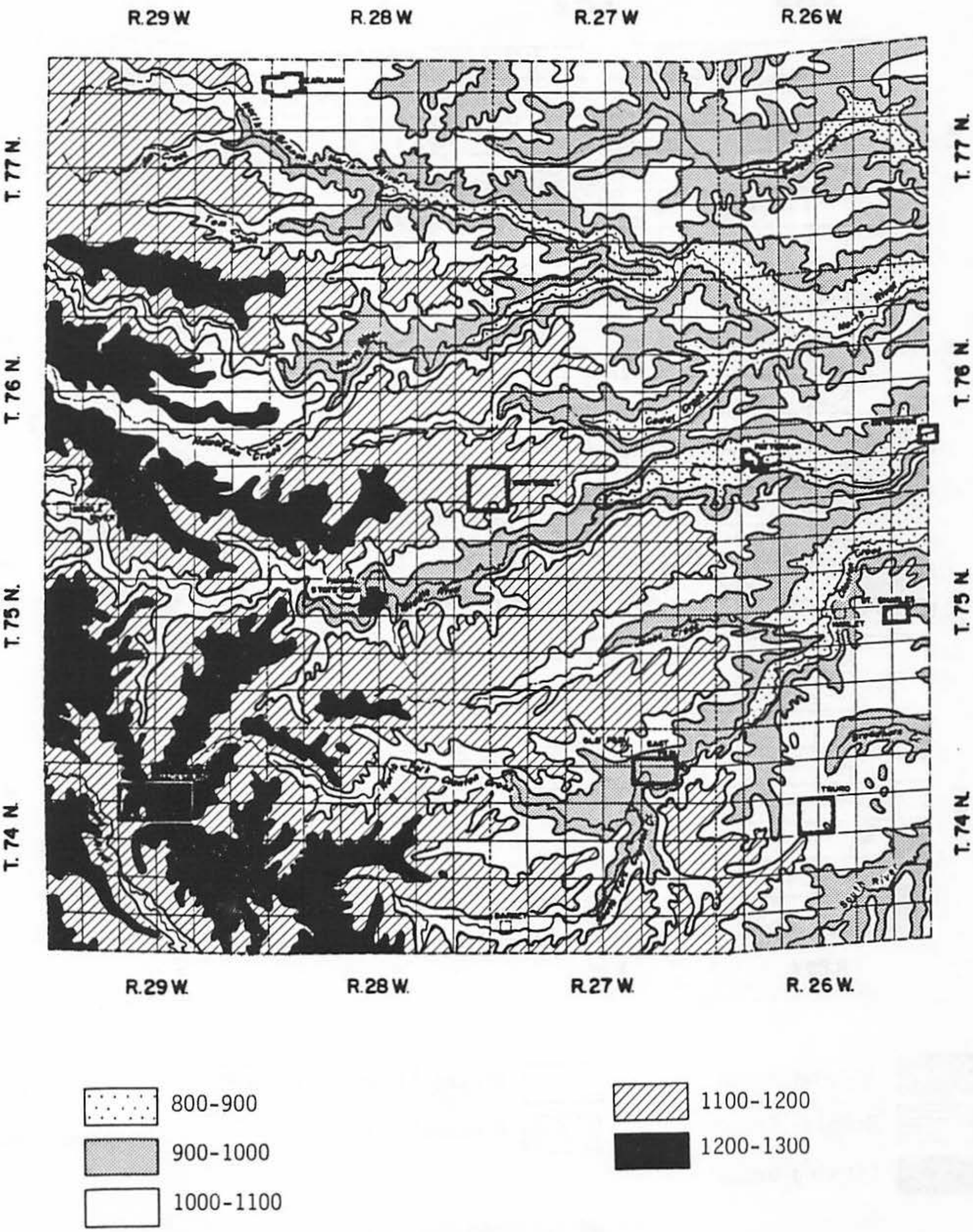
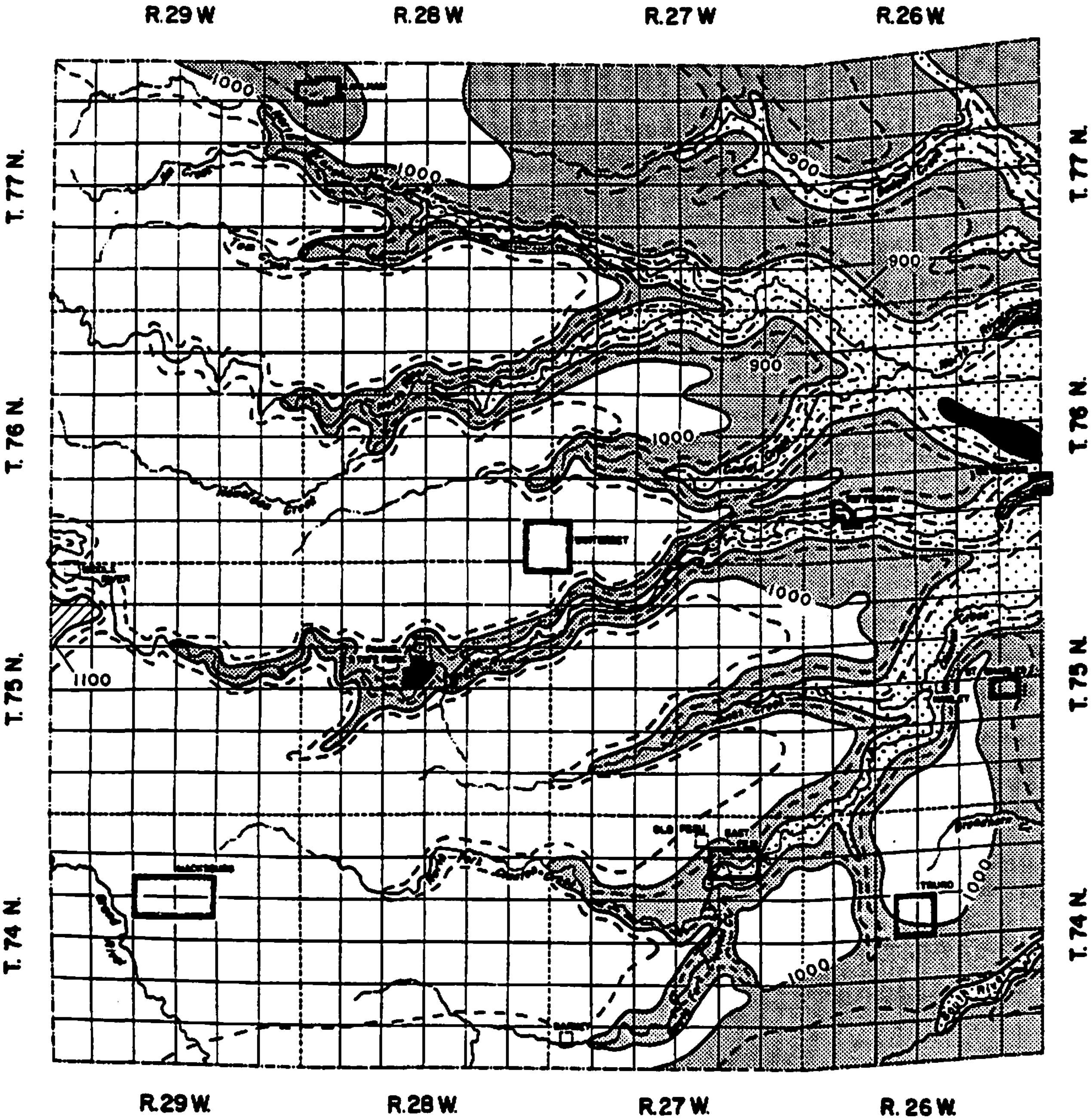


Figure 5

ELEVATION OF BEDROCK SURFACE OF MADISON COUNTY IN FEET ABOVE MEAN SEA LEVEL



700-800	1000-1100
800-900	1100-1200
900-1000	Supplemental 50 foot contour

Figure 6

RANGE IN DEPTH TO PRINCIPAL ROCK AQUIFERS IN MADISON COUNTY

	R-29W	R-28W	R-27W	R-26W
T-77N	BEDROCK 0-250 MISSISSIPPIAN 650-1050 SILURIAN-DEVONIAN 1000-1550 CAMBRO-ORDOVICIAN 2250-2750	BEDROCK 0-150 MISSISSIPPIAN 525-950 SILURIAN-DEVONIAN 1100-1525 CAMBRO-ORDOVICIAN 2175-2600	BEDROCK 0-100 MISSISSIPPIAN 400-800 SILURIAN-DEVONIAN 1025-1400 CAMBRO-ORDOVICIAN 2050-2400	BEDROCK 0-150 MISSISSIPPIAN 350-725 SILURIAN-DEVONIAN 950-1325 CAMBRO-ORDOVICIAN 2000-2325
T-76N	BEDROCK 0-250 MISSISSIPPIAN 750-1150 SILURIAN-DEVONIAN 1250-1650 CAMBRO-ORDOVICIAN 2400-2750	BEDROCK 0-200 MISSISSIPPIAN 625-1050 SILURIAN-DEVONIAN 1200-1600 CAMBRO-ORDOVICIAN 2225-2650	BEDROCK 0-150 MISSISSIPPIAN 450-950 SILURIAN-DEVONIAN 1025-1475 CAMBRO-ORDOVICIAN 2050-2525	BEDROCK 0-100 MISSISSIPPIAN 350-725 SILURIAN-DEVONIAN 975-1325 CAMBRO-ORDOVICIAN 2000-2350
T-75N	BEDROCK 0-250 MISSISSIPPIAN 800-1150 SILURIAN-DEVONIAN 1400-1750 CAMBRO-ORDOVICIAN 2400-2750	BEDROCK 0-250 MISSISSIPPIAN 625-1100 SILURIAN-DEVONIAN 1200-1700 CAMBRO-ORDOVICIAN 2225-2700	BEDROCK 0-150 MISSISSIPPIAN 550-950 SILURIAN-DEVONIAN 1150-1525 CAMBRO-ORDOVICIAN 2175-2525	BEDROCK 0-50 MISSISSIPPIAN 425-775 SILURIAN-DEVONIAN 1025-1375 CAMBRO-ORDOVICIAN 2050-2300
T-74N	BEDROCK 0-250 MISSISSIPPIAN 900-1200 SILURIAN-DEVONIAN 1450-1750 CAMBRO-ORDOVICIAN 2450-2750	BEDROCK 0-250 MISSISSIPPIAN 775-1150 SILURIAN-DEVONIAN 1350-1725 CAMBRO-ORDOVICIAN 2325-2700	BEDROCK 0-150 MISSISSIPPIAN 600-1000 SILURIAN-DEVONIAN 1200-1550 CAMBRO-ORDOVICIAN 2175-2525	BEDROCK 0-150 MISSISSIPPIAN 500-950 SILURIAN-DEVONIAN 1175-1500 CAMBRO-ORDOVICIAN 2100-2450

Figure 7

INDEX MAP FOR TYPICAL WELLS IN MADISON COUNTY

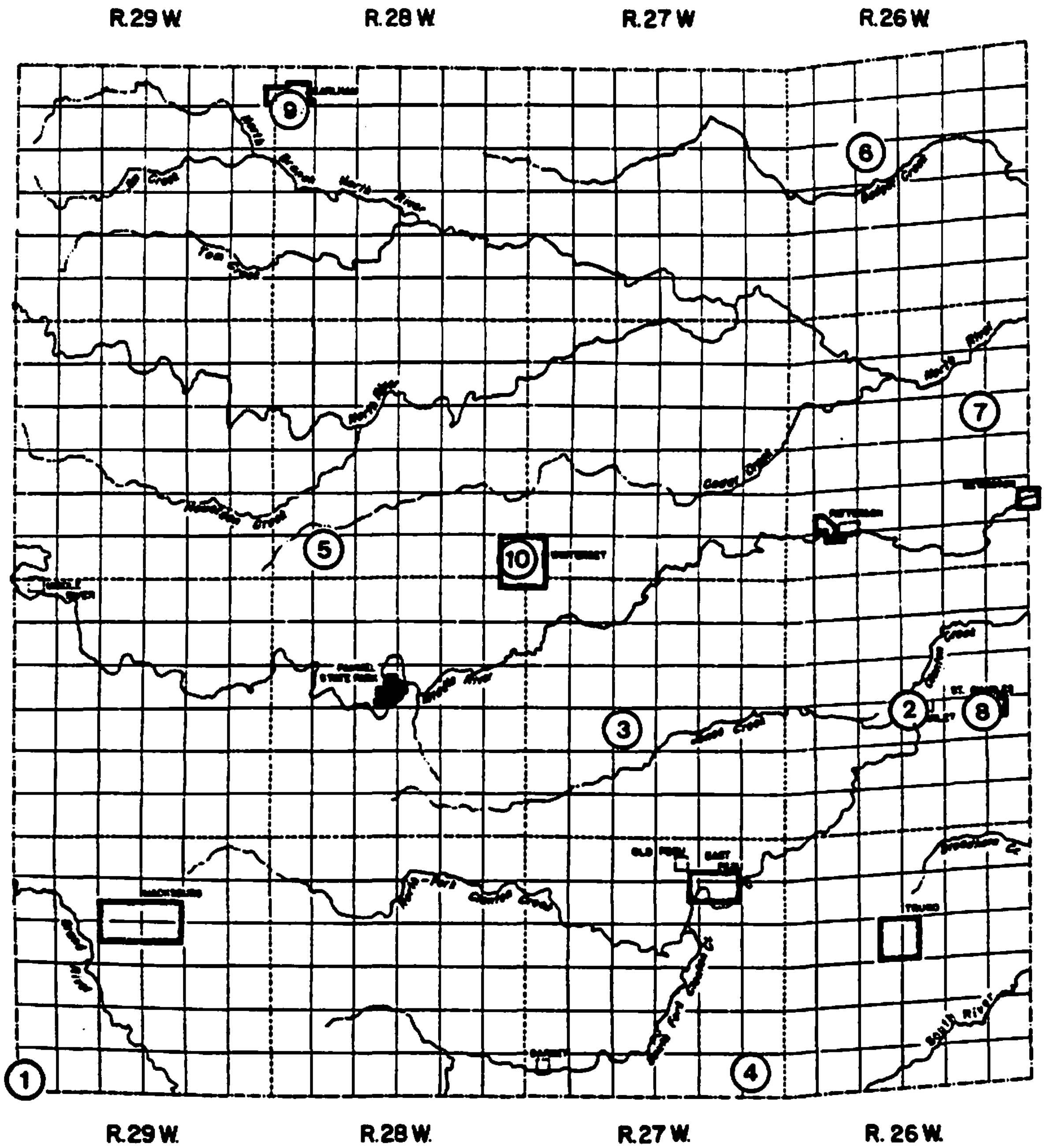


Figure 8

TYPICAL WELLS IN MADISON COUNTY

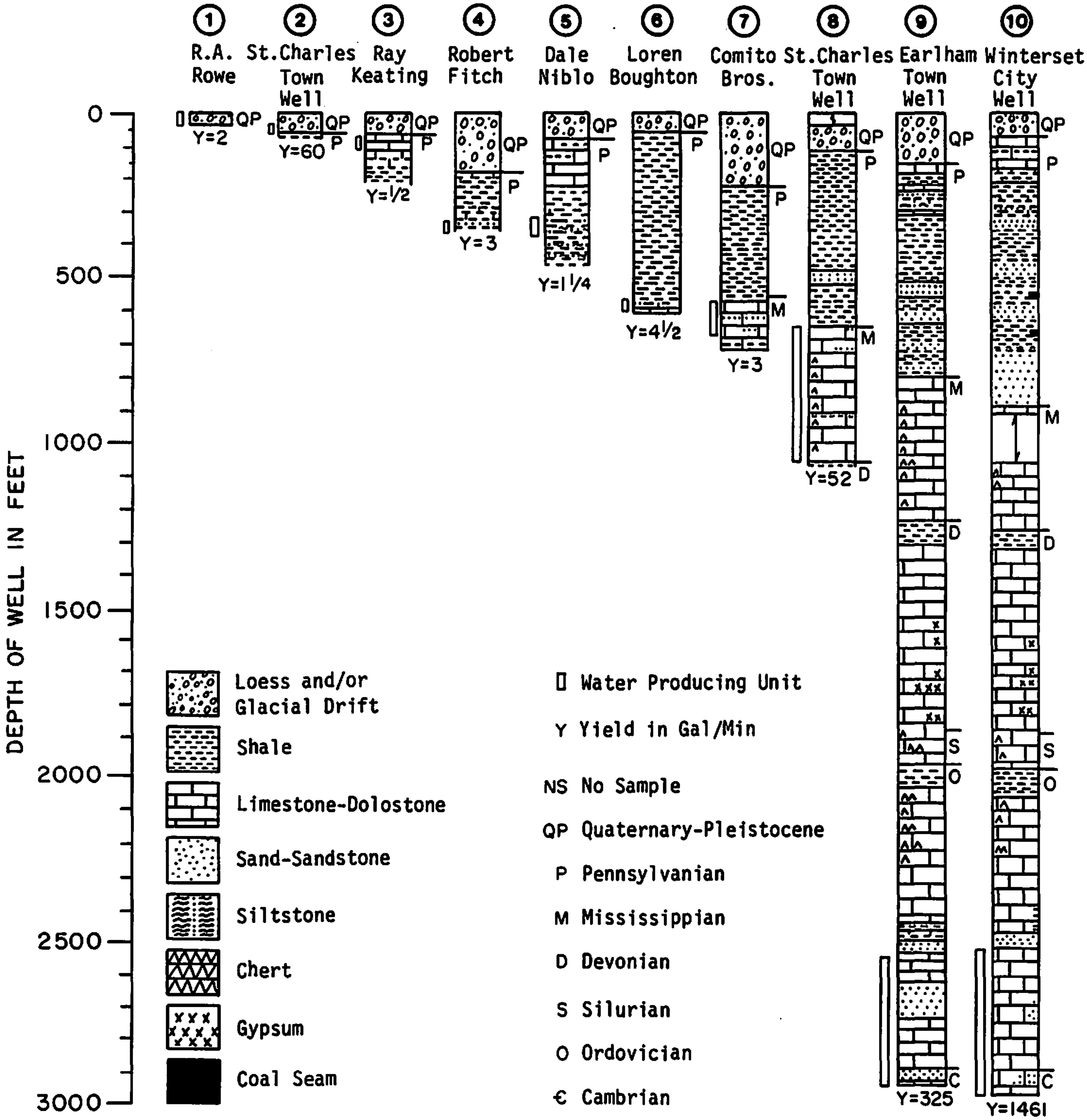


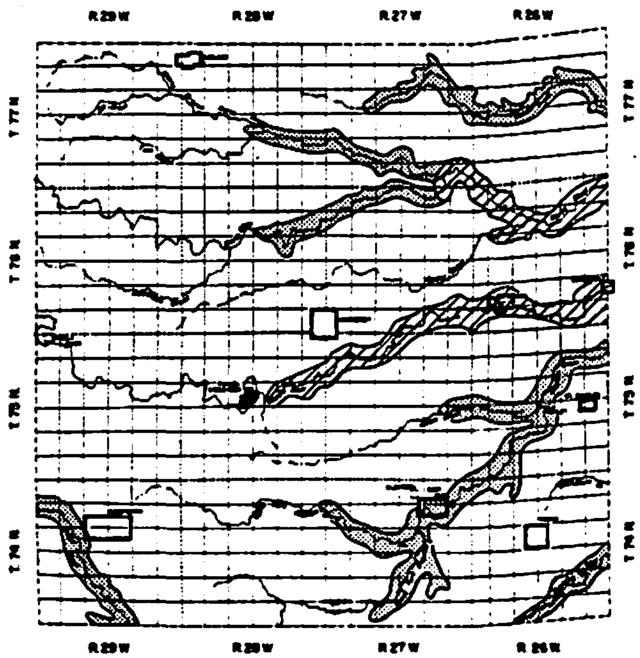
Figure 9

SURFICIAL AQUIFERS IN MADISON COUNTY

Water Levels

Water levels in the surficial aquifers are difficult to analyze because water rises to different levels in wells drilled into alluvial, buried-channel, and drift aquifers. The water table in the shallower drift aquifers generally slopes from high land areas toward stream valleys and changes noticeably throughout the year in response to recharge from precipitation. Water levels in alluvial aquifers fluctuate in the same way as those in the shallow drift aquifers; however, the main influence on alluvial aquifers is the stage (level) of the associated stream. Water levels will be high during periods of high stream stage and low during the low stage periods. The deeper drift aquifers and the buried-channel aquifers are confined, and the water is under artesian pressure.

Water levels in the shallow drift aquifers commonly are from 10 to 50 feet below the land surface, and those in the deeper drift and buried-channel aquifers range between 100 and 150 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 table will be accordingly deeper in wells located on terrace surfaces.



Water yields to wells in gallons per minute

Alluvial aquifers

10-25 (35)*

25-50 (75)

50-150 (225)

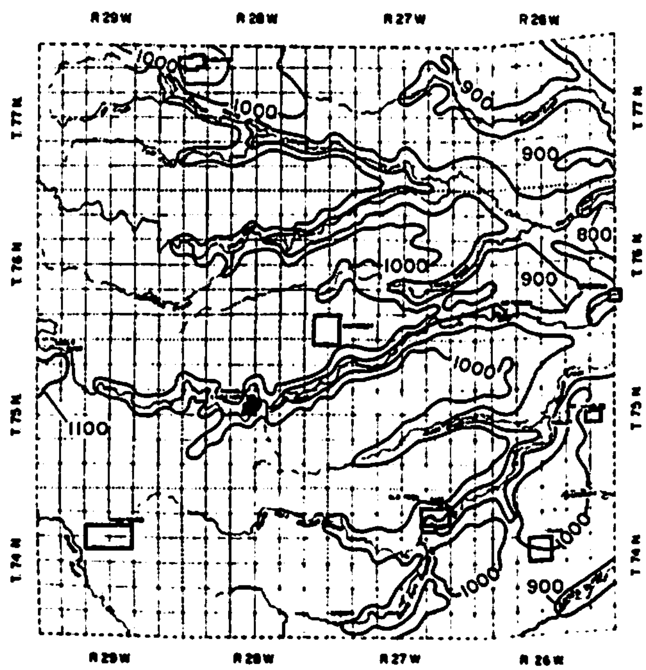
Drift aquifer 1-5 (10)

*(35) number is maximum yield that is occasionally available but probably not on a sustained basis.

Figure 10

PENNSYLVANIAN AQUICLUDE IN MADISON COUNTY

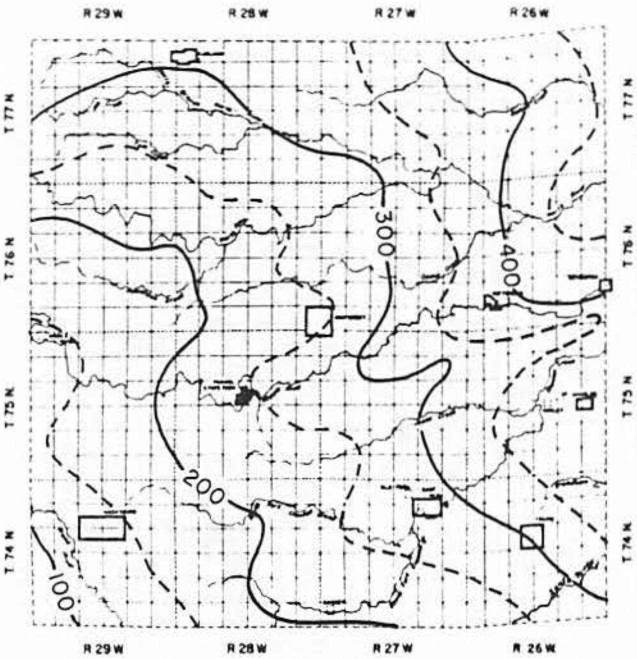
The Pennsylvanian Aquiclude generally underlies the whole county and is thickest in the western portions of the county. Pennsylvanian strata consist of a succession of shale, limestone, siltstone, sandstone and coal beds. Locally within the Kansas City and Cherokee Groups (Figure 3), the limestone and sandstone beds are water-bearing. Estimates of the yields from those aquifers are generally less than 25 gpm and usually between 3 and 10 gpm.



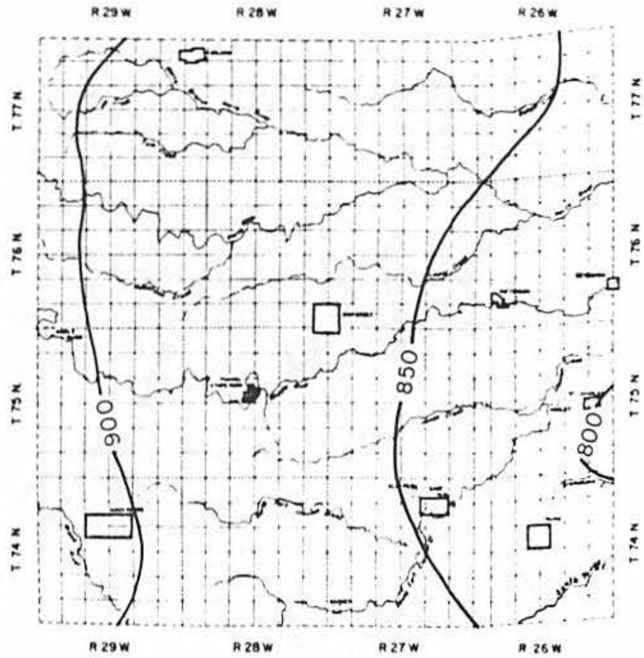
Elevation of the top of the Pennsylvanian Aquiclude in feet above mean sea level

Figure 11

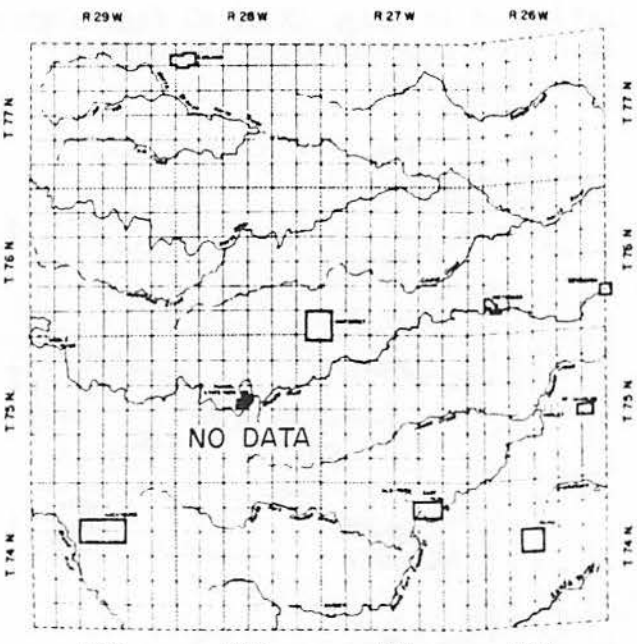
MISSISSIPPIAN AQUIFER IN MADISON COUNTY



Elevation of top of the Mississippian Aquifer in feet above mean sea level

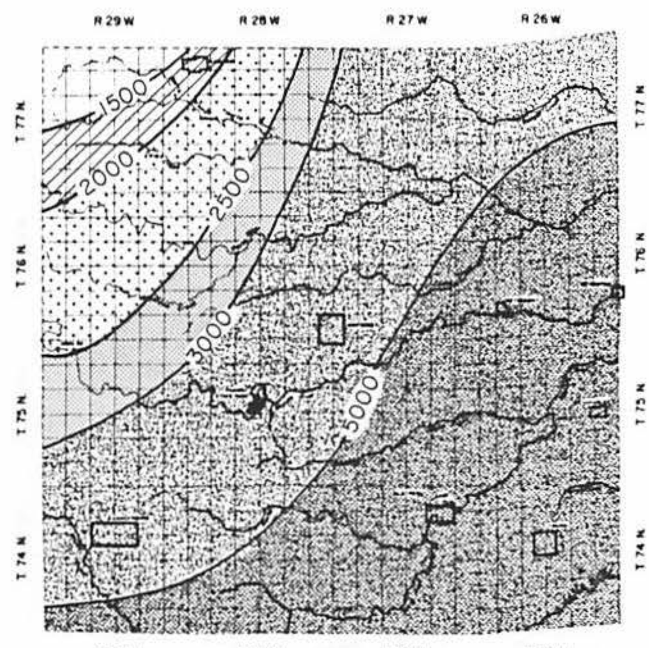


Water levels in wells in feet above mean sea level



Water yields of wells in gallons per minute

Estimated to range from 5 to 60 gpm with occasional yields of 100 gpm potentially available

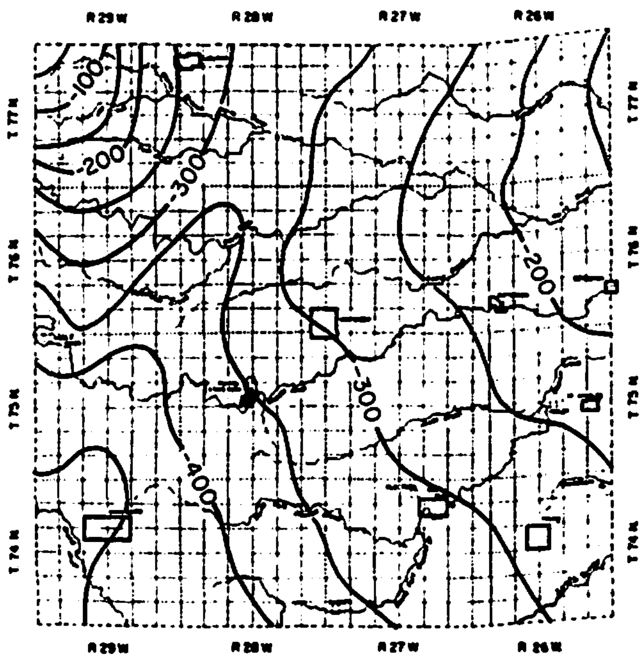


Dissolved solids content in milligrams per liter (mg/l)*

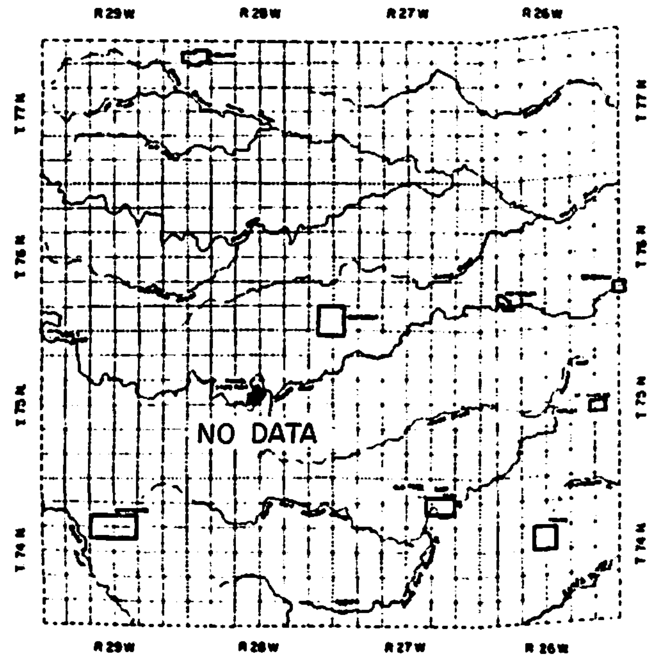
- Less than 1500
- 1500-2000
- 2000-25000
- 2500-3000
- 3000-5000
- Over 5000

Figure 12

DEVONIAN-SILURIAN AQUIFER IN MADISON COUNTY

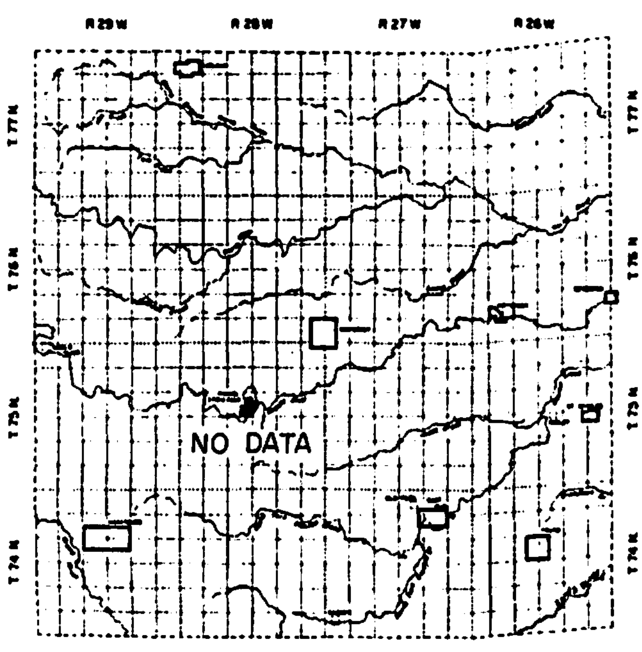


Elevation of top of the Devonian Aquifer in feet above mean sea level



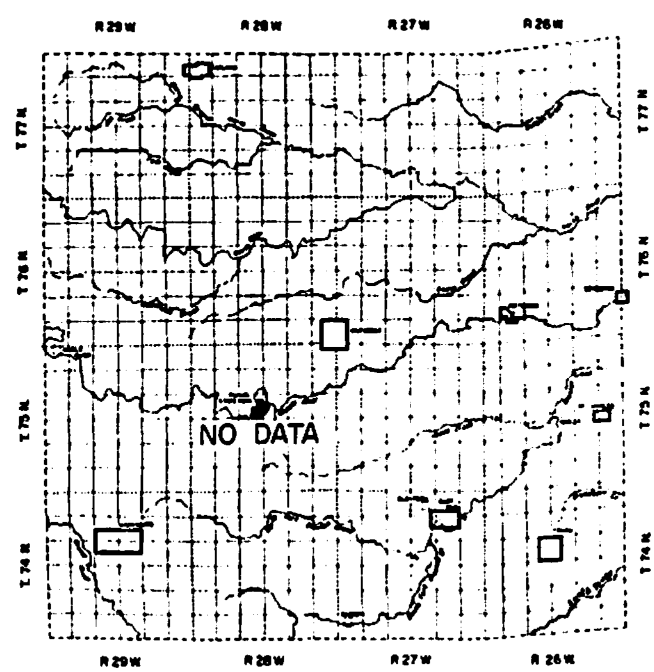
Water levels in wells in feet above mean sea level

Estimated to range about 50 feet higher than the Cambro-Ordovician aquifer (See Figure 13)



Water yields of wells in gallons per minute

Estimated to range from 20-100 gpm

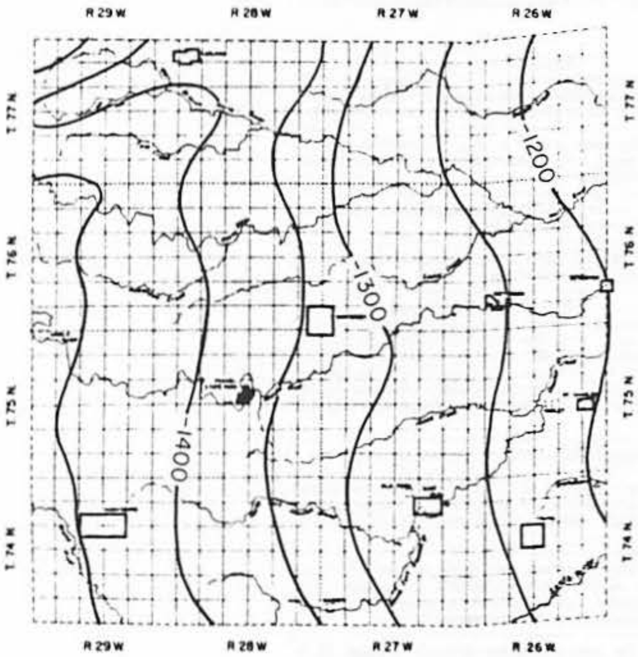


Dissolved-solids content in milligrams per liter (mg/l)

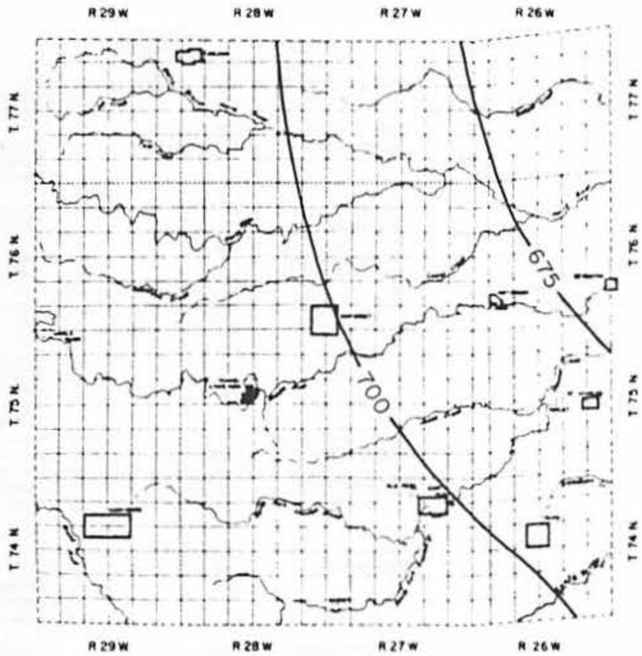
Estimated to range from 5,000 to 10,000 mg/l

Figure 13

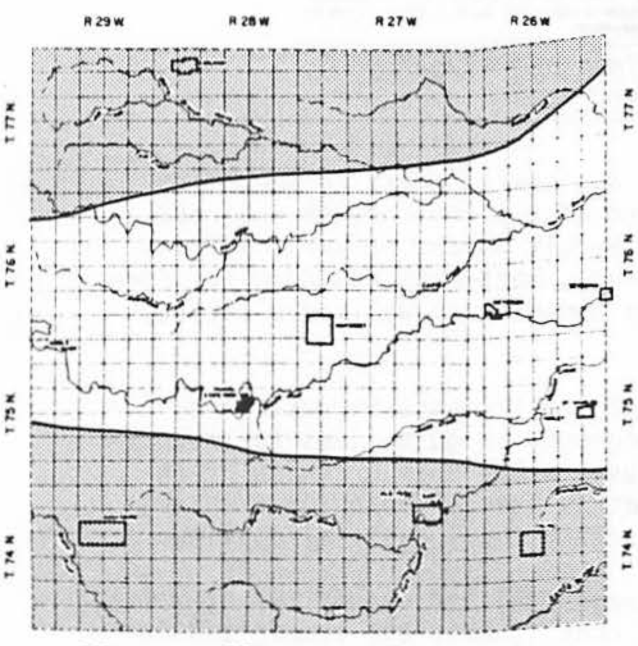
CAMBRO-ORDOVICIAN (JORDAN) AQUIFER IN MADISON COUNTY



Elevation of top of Cambrian-Ordovician Aquifer in feet above mean sea level



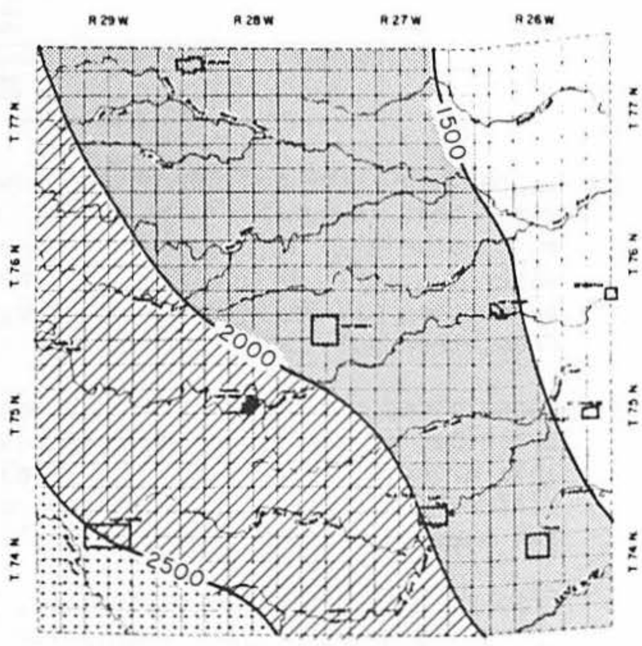
Water levels in wells in feet above mean sea level



Water yields of wells in gallons per minute

500-1000

More than 1000



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

Less than 1500

2000-2500

1500-2000

More than 2500

*Other water quality data in Table 4

Table 2

SIGNIFICANCE OF MINERAL CONSTITUENTS AND PHYSICAL PROPERTIES OF WATER

Constituent or Property	Maximum Recommended Concentration	Significance
Iron (Fe)	0.3 mg/l	Objectional as it causes red and brown staining of clothing and porcelain. High concentrations affect the color and taste of beverages.
Manganese (Mn)	0.05 mg/l	Objectionable for the same reasons as iron. When both iron and manganese are present, it is recommended that the total concentration not exceed 0.3 mg/l.
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 laxative 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 laxative 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	In central Iowa, 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 sewage, decayed organic matter, nitrate in the soil, or chemical fertilizer.
Dissolved solids	500 mg/l	This refers to all of the material in water that is in solution. It affects the chemical and physical properties of water for many uses. Amounts over 2,000 mg/l will have a laxative 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 milligrams per liter 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.

To the user, the quality of groundwater is as important as the amount of water that an aquifer will yield. As groundwater 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 the common mineral constituents in water are described in the table above. These are 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 past analyses of groundwater, the 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 Madison 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.

Table 3

CHEMICAL CHARACTER OF GROUNDWATER

Surficial Aquifers

Average (A) and range (R)	Dissolved solids	Hardness (as $CaCO_3$)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Sodium (Na)	Iron (Fe)	Manganese (Mn)
				Alluvial aquifer					
A	417	288	105	13	0.3	4.2	20.2	9.4	1.5
R	165-1000	124-762	3-350	0.5-180	0.1-0.45	0.1-17	4.1-85	0.04-51	0.05-17
				Shallow drift aquifer					
A	736	480	177	37	0.3	81	68	1.1	0.13
R	220-2840	153-1710	12-1470	0.5-200	0.2-0.8	0.1-570	7.3-710	0.02-30	0.05-1.9
				Intermediate drift aquifer					
A	1030	569	397	9	0.5	6	108	5	0.09
R	261-2726	150-1518	7-1520	0.5-49	0.2-1.0	0-44	17-368	0.04-24	0.05-0.37
				Deep drift and Buried-channel aquifers					
A	2346	868	1254	30	0.6	6.7	334	3.4	0.24
	383-3657	140-1640	42-1990	3-110	0.1-2.0	0-82	54-568	0-18	0-1.4

The alluvial aquifers yield the least mineralized water of all groundwater sources in south-central Iowa. In the alluvial aquifers, manganese and iron concentrations are well above recommended standards, but all other constituents are well below. Water temperatures average 55°F (13°C), and the range of these temperatures is from 46°F to 60°F (8°C to 16°C).

In the shallow drift aquifers (less than 100 feet), the water is hard with high iron and dissolved solids and may contain undesirable concentrations of sulfate, nitrate, and chloride. High concentrations of nitrate, chloride and bacteria are directly due to contamination of wells or the infiltration of agricultural waste water and runnoff into shallow drift aquifers. The water from these aquifers is usually acceptable for most purposes if wells are constructed properly and located a suitable distance from sources of contamination. Nitrate content should be checked carefully in these wells, and any water supply containing over 45 mg/l should not be used for infant feeding. Water temperatures average 54°F (12°C), and the range of these temperatures is from 50°F to 60°F (10°C to 16°C).

In the intermediate drift aquifer (100-200 feet), water is more highly mineralized than the shallow drift aquifer, with iron concentrations high and nitrate low. The fluoride content, hardness, and temperature are similar to the shallow drift aquifer.

In the deep drift and buried-channel aquifers, the water is highly mineralized and contains high concentrations of dissolved solids, sulfate and iron. Water temperatures range between 54°F and 57°F (12°C to 14°C).

Table 4

CHEMICAL CHARACTER OF GROUNDWATER

Bedrock Aquifers

Average (A) and range (R)	Dissolved solids	Hardness (as $CaCO_3$)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Sodium (Na)	Iron (Fe)	Manganese (Mn)
				Pennsylvanian (Cherokee Group) aquifers					
A	4531	869	1088	97	1.4	3.5	536	3.2	0.15
R	251-7092	44-1559	22-4139	0.5-780	0.2-4.0	0-50	7-2180	0.1-22	0-4
				Mississippian aquifer in area outside Madison County					
A	4274	923	2385	176	1.9	8.4	965	7.6	0.11
R	1210-8400	60-1580	521-4500	19-750	1.0-3.6	0-150	270-2100	0.05-23	0-0.34
				Cambrian-Ordovidian aquifer					
A	1098	370	397	150	2.3	1.2	226	2.4	0.05
R	614-2560	246-1100	190-930	29-620	1.2-3.2	0.08-5.5	100-520	0.04-10	0.01-0.10

Because it is highly mineralized, water in the bedrock aquifers is of limited use in many parts of south-central Iowa. Only with extensive treatment is it suitable for domestic and industrial uses; without treatment, it can be used for washing, cooling, and fire fighting.

Pennsylvanian sources in Madison County yield highly mineralized water. Sulfate concentrations are very high, as are sodium and total dissolved solids. Water temperatures average 56°F (13°C) and range between 52°F to 61°F (11°C to 16°C).

Water from the Mississippian Aquifer is highly mineralized with dissolved solids concentrations generally exceeding 3000 mg/l. Water temperatures average 57°F (14°C) and range between 52°F and 64°F (11°C to 18°C).

Chemical-quality data is available from only two wells in the Devonian Aquifer in the vicinity, but from these some general assumptions can be made. The sulfate content of the aquifer is high, due to the occurrence of evaporite minerals (gypsum and anhydrite). Water obtained from the Devonian Aquifer can be expected to contain dissolved-solids concentrations in a range from 5,000 to 10,000 mg/l, with chloride, sodium and sulfate concentrations that are as high as 1,000, 2,000, and 2,500 mg/l respectively or higher.

Water from the Cambrian-Ordovician Aquifer is generally better quality than water from the over-lying bedrock aquifers. However, sulfate, iron, fluoride, sodium, and dissolved-solids concentrations are high and increase toward the southwestern part of the county. Temperatures range from 75°F to 85°F (24°C to 29°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:

- size of well, casing specifications, and types of screen and well seal
- methods of eliminating surface and subsurface contamination
- 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 sucdh 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 building and wired separately for power, continued use of the water supply will not be jeopardized by fire in major buildings.

Water Treatment

Water taken from a private well ideally should 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 Univerity 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 $4.00 each; for iron and hardness, it is $5.00 each; and for iron bacteria, $10.00. 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 at any time these are opened for repairs or remodeling. A strong chlorine solution is placed in the well and 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 water in Madison County is 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 softner 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 it 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 5 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 ground-water supply or contracting for the drilling of a new well, additional specific information is often required. This section lists several sources and types of additional information.

State Agencies That May Be Consulted

Geological Survey Bureau-DNR[1]	123 North Capitol Iowa City 52242	(319) 338-1173
State Health Department [2,6]	Lucas Building Des Moines 50319	(515) 281-5787
Iowa Dept. of Natural Resources[3,4]	Wallace Building Des Moines 50319	(515) 281-6284
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 respository, consultant on well problems, water development and related services

2 Drinking-water quality, public and private water supplies

3 Water-withdrawal regulation and Water Permits for wells 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 are within an approximate radius of 50 miles of Madison County. For a statewide listing contact either the Iowa Water Well Drillers Association, 4350 Hopewell Avenue, Bettendorf, IA 51712, (319) 355-7528 or the Iowa Geological Survey, (319) 338-1173.

Elmer Baker
Elmer Baker Well Co.
Mount Ayr, IA 50854

Bruinekool Well Company
Pella, IA 50219

Bruinekool Well Company
Perry, IA 50220

Dewey Well Company
Box 177
Slater, IA 50244

Donald L. Hicks
Hicks Well LCompany
Scranton, IA 51402

Huff Well Drilling Co.
R R. 1
Winterset, IA 50237

Tom Hughes Well Co.
4120 - 73rd Street
Des Moines, IA 51462

Layne-Western Company, Inc.
705 South Duff Street
Ames, IA 50010

Longfellow and Son
Clearfield, IA 50840

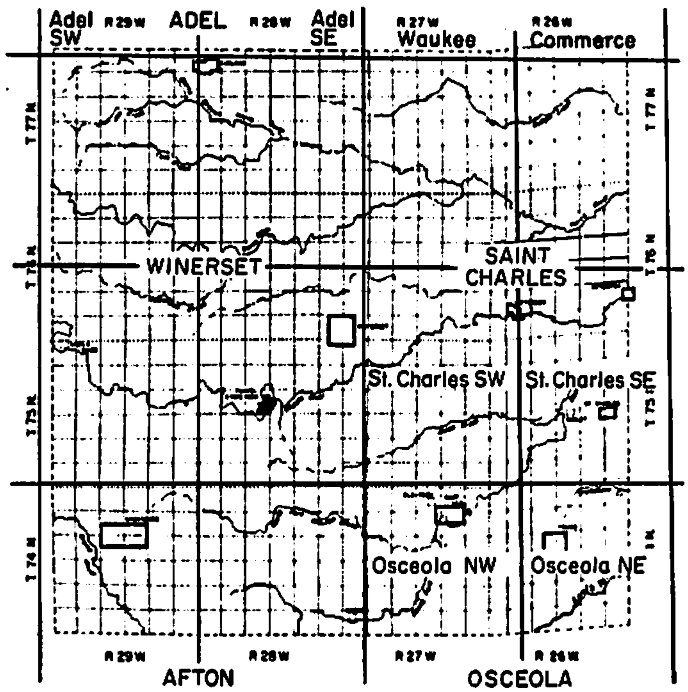
Jerry Reiwertz
1133 - 9th Street
Nevada, IA 50201

Phil Ridout
Stanley Well Co.
Massena, IA 50853

Thorpe Well Co.
Ankeny, IA 50021

Daryl Whalen & Son
Whalen Well Co.
1407 - 1st Avenue West
Newton, IA 50208

TOPOGRAPHIC MAPS OF MADISON COUNTY
(Available from the Geological Survey Bureau - DNR)



Map Title	Date Published	Scale	Contour Interval
Adel	1949	1:62500	20 feet
Winterset	1952	1:62500	20 feet
Saint Charles	1951	1:62500	20 feet
Afton	1951	1:62500	20 feet
Osceola	1951	1:62500	20 feet
Waukee	1965	1:24000	10 feet
Commerce	1965	1:24000	10 feet
Cumming	1972	1:24000	10 feet

*Mapping in Progress

Adel SW	St. Charles NW	Osceola NW
Adel SE	St. Charles SW	Osceola NE
	St. Charles SE	

Useful Reference Materials*

Cagle, Joseph W., and Heinitz, A.J., 1978, Water Resources of South-Central Iowa, Iowa Geological Survey, Water Atlas No. 5.

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.

Gordon, D.L., 1987, Guidelines for Plugging Abandoned Water Wells, Geological Survey Bureau-DNR, Technical Information Series No. 15.

* The data presented in this report has been compiled from Cagle and Heinitz (1978), Horick and Steinhilber (1973 and 1978), and from well logs on file at the Iowa Geological Survey.